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Ford Reconditions Engines at the Factory

H. C. DECKARD

Volume business permits the use of assembly line methods and time-saving equipment impossible in a service station

FOR SOME TIME Ford owners have been offered a factory reconditioned engine in exchange for the old one at less than fifty dollars. How the work is done at the Ford River Rouge plant and why it is possible at such a price are explained in what follows. Instead of the several days of delay to which the car owner has been accustomed while his engine was undergoing an overhaul, he can now have the engine replaced by one that has been completely reconditioned at the Ford factory, the complete change requiring but a few hours.

Ford branches and dealers carry a stock of reconditioned engines, Types A and B four-cylinder as well as the V-8 being subject to this type of service. The service station removes the non-wearing parts such as oil pan, exhaust and intake manifolds and similar parts before sending the engine back to the factory. The engines are returned to the branch or service station after rebuilding, less these parts which are replaced when the engines are received. The engines reach the factory in special bolted packing cases. After uncrating they are placed on a disassembly line where they are completely torn down. The heads are taken off, the piston and connecting rod assemblies removed, the crankshafts and camshafts taken out. All studs and cap screws are removed.

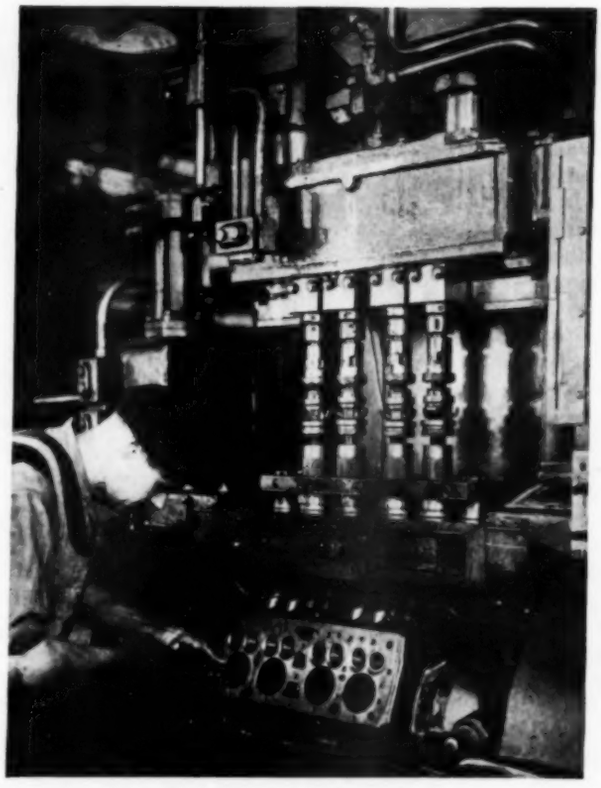


Fig. 1—Indicating a cylinder bore for size, straightness and concentricity after it has been honed in the hydraulically controlled machine illustrated

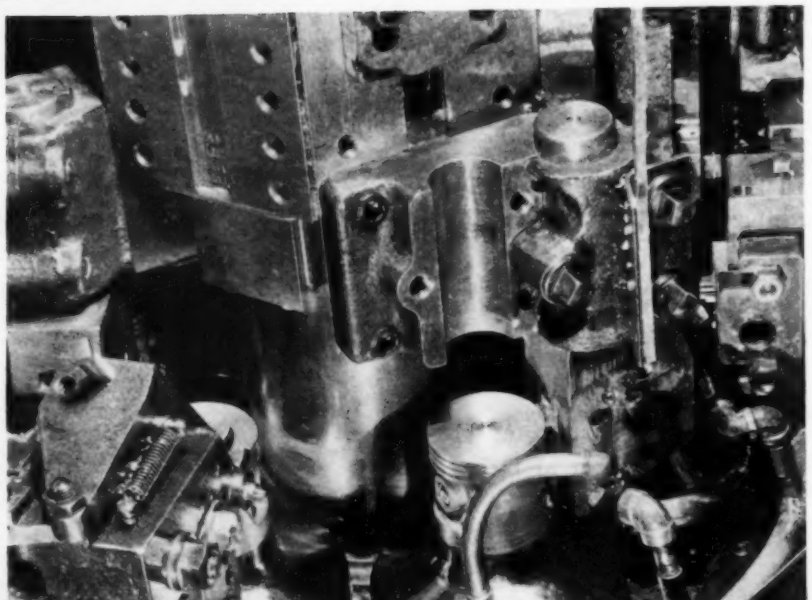
In other words, on the disassembling line, the operations are progressively performed in just the reverse order of those on the assembly line. The same types of electric wrenches, stud drivers and other tools are used, but they, too, are naturally in reverse.

After the disassembly the gears, studs, screws, pistons and rings are all scrapped. The cylinder block, crankshaft and camshaft are sent to their respective departments. This procedure is carried out on both the four- and eight-cylinder engines. All major parts are returned to the departments where they were originally ma-

Fig. 2—Running-in stands at the end of the V-8 assembly line

Fig. 4—Piston pin inspection and grading machine operated through photo-cell control. Its capacity is 11,000 pins in 8 hours

Fig. 3—Semi-automatic turning oversize pistons for reconditioned engines. 4,000 pistons a day are needed



chined. Here they are thoroughly inspected and passed for rework or to be scrapped. There is a separate line, both for assembly and disassembly, for the fours and eights.

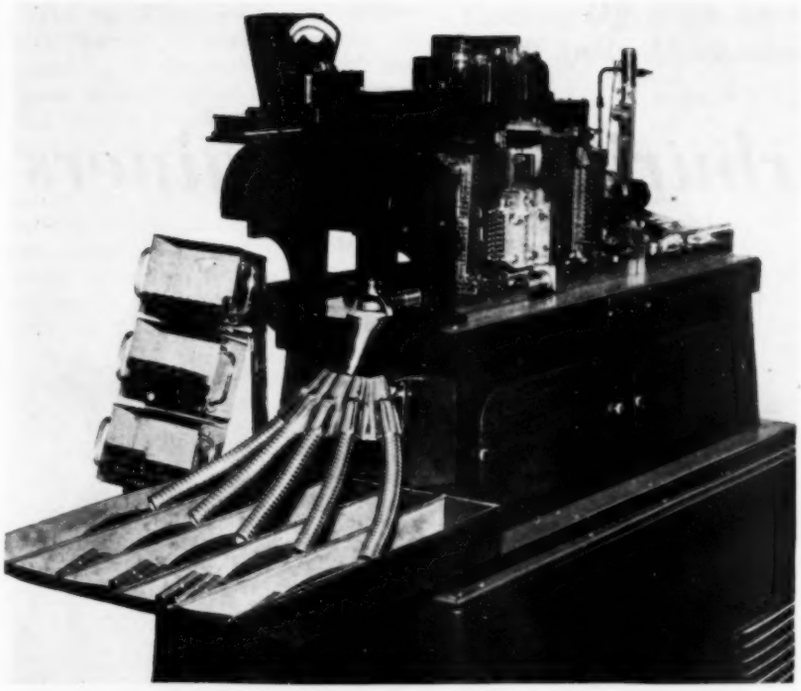
The cylinder blocks are rebored and honed to standard oversize dimensions, the same close limit as to size that prevails on the new motors being maintained in the reconditioning operations.

The sizes allowable on reboring and honing are standard—plus 0.015 in. plus or minus 0.0005 in.; plus 0.030 in., plus or minus 0.0005 in.; plus 0.045 in., plus or minus 0.0005 in.; plus 0.060 in., plus or minus 0.0005 in. This allows for four oversize standards. The vast majority of rebuilt engines are either plus 0.015 in. or plus 0.030 in. The man in charge of the department also informs me that approximately 25 per cent of all the reconditioned engines are equipped with new blocks. These, however, are bored and honed to standard plus 0.015 in. on the hydraulic-feed boring machine shown in Fig. 1.

After reboring and honing, the blocks and caps are rebabbitted, the push rod holes rebushed where necessary, the valve seats bored out and the new high tungsten valve inserts put in. These inserts are standard on all reconditioned engines. To insure an absolutely tight fit on the valve inserts they have a reverse shrink fit. The inserts are contracted by cooling in liquid air and then pressed in place. They are a very tight fit when they return to normal temperature. When the engine heats up they are expanded further, insuring against any chance of loosening.

After remachining and inspection in the cylinder department the blocks are delivered to the motor building where the valve seats are reamed and ground. They next pass through a washing machine to remove all grinding dust. The crankshaft bearings are bored and the block is inspected. The transmission dowel pin holes are inspected and reamed, if necessary. All oil lines are cleaned by compressed air.

The blocks are next washed and thoroughly cleaned in a caustic soda solution at 180 deg. F. After washing they go through the paint booths on conveyors where they are spray-painted. The



paint, due to the heat generated in the washing, dries very quickly. The oil lines are again cleaned by forcing kerosene through them. This also acts as a test for porosity as the kerosene is forced through under high pressure.

The blocks are next tested with a special micrometer depth gage for distance of valve seats to camshaft. The plus or minus distance over and below standard is marked on the block for each valve seat. The valve stems, bushings, springs and other parts are assembled and grouped according to length from the valve seat to the end of the stem. The push rods or tappets are ground to plus or minus 0.001 in. limit on length.

Re-assembly

The cylinder block, after the valve seat depth is marked, is immediately placed on the assembly line, Fig. 2. The camshaft is assembled and the valves and push rods are put in place. Valve assemblies are selected according to the markings on the cylinder block. New studs are driven home. The crankshaft, piston and other assemblies are added as the engine takes form on the line.

Each operation is handled in the same way on the assembly line as is the corresponding operation on a new engine. The split-skirt aluminum alloy pistons are machined as shown in Fig. 3. The side wall clearance is tested in each cylinder by means of a standard thickness gage fastened to the end of an ordinary spring scale. The inspector pulls the thickness gage from between the piston and the side wall of the cylinder. The pounds of pull are registered on the scale and all cylinders within a very close limit are alike.

Standard sizes are used in the reworking of these parts and the same close limits used on new parts prevail throughout. Crankshafts are ground and lapped 0.005 in. undersize on the main bearings and 0.003 in. on the connecting rod bearings. The camshaft is ground undersize on the bearings.

Very few new crankshafts are needed or used for the reconditioned engines, but approximately 30 per cent of the engines require new camshafts. Very few new connecting rods are required. On the V-8 the faces of the rod and cap are ground off 0.002 in. each and all bores reground. On the 4-cylinder engines the rods and caps are all rebabbitted, and rebored to the new standard size. All V-8 engines are equipped with the new copper-lead full floating bushings.

All gaskets throughout are new, as are the oil pump idler gears. All oil pump pressure springs are new and tested for pressure before assembly. Cylinder heads are wire brushed and thoroughly cleaned. They are water tested and if they do not test 100 per cent they are replaced with new ones.

All piston pins are reinspected. The Ford Motor Company has a specially designed machine, Fig. 4, which automatically tests the piston pins for hardness, concentricity, straightness and size. All pins are held to 0.001 in. for concentricity and straightness. They are graded by 0.0001 in. for size by this machine. The funnel shaped spout automatically delivers them to the tube leading to the bin in which they belong.

The pins that do not fall within these limits are automatically thrown out, either for reworking or for scrap. The inspection machine is controlled by a series of photo cells, which perform the separate operations as the pins are fed through automatically from a hopper. Its intermittent motion allows the barest fraction of time for each inspection, and it thoroughly inspects and grades 11,000 pins in eight hours.

In spite of the cost of all the new parts and the transportation charges to and from the factory, the new type of service costs less to the customer than a service station overhaul. This is made possible by the volume and the equipment available for progressively performing this work. No service station could afford or have the available space for the special equipment made possible by the volume production obtained on this reconditioning job. Production on reconditioned engines is approximately 700 daily, most of the production consisting of fours because so many more cars equipped with this engine are in use.

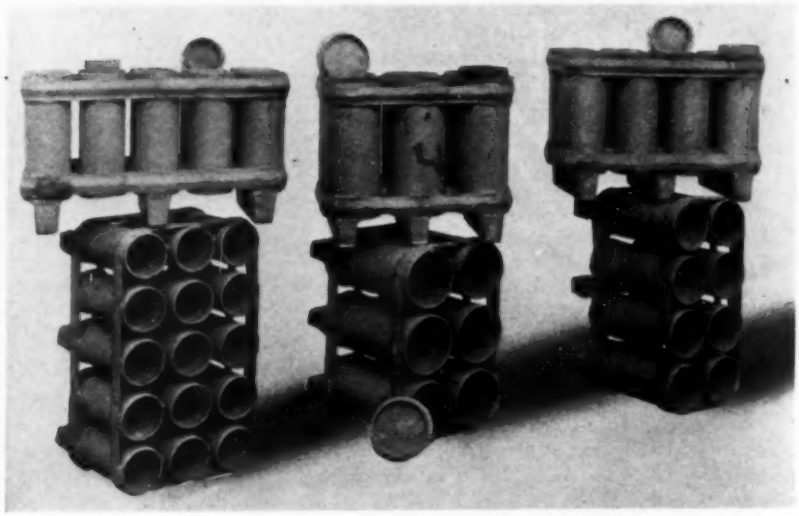
In addition to the carburetor, manifolds and oil pan, the distributor, starting motor and generator are removed before shipping the engine to the factory. These parts are tested at the service station and if found defective in any way they are returned separately for reconditioning.

Other Units Rebuilt at the Factory

In fact no service work on such parts as distributor, carburetor, shock absorbers, fuel pump or clutch parts is performed by the service stations. If these parts are found defective at any time they are removed and factory-rebuilt units are put on at a minimum charge. The units replaced are returned to the factory and rebuilt or scrapped, in much the same manner as the engines. After reconditioning and testing, the engines are placed in the special cases and shipped to the various branches for distribution.

The writer was informed by Harry Martin, Service Manager for the Ford Motor Company, that the cost of having the engine or sub-assembly replaced with a reconditioned unit is the same for all parts of the country east of the Rocky Mountains. The charge is slightly higher west of the Rockies. He explains further that the company can only afford to do this because of the large volume production and shipments.

Alloys for Carburizing Containers



Various sizes of a carburizing container constructed of welded heat-resisting sheet steel

EDWIN F. CONE

WHILE there has been a refinement in recent years in carburizing compounds as well as in furnaces, the developments in boxes or containers have not been striking. They still consist of the cast box which is now made of heat-resisting material replacing cast iron or cast steel—the latter, chrominum-nickel-iron alloys, being a decided step forward. Into most of these containers, usually cylindrical or rectangular, some of which have diameters up to 18 in., several pieces to be carburized are inserted and charged with the carburizing compound. Sometimes there is as much as an inch or two of compound between the work and the container wall.

Long pieces packed horizontally in such a box have had a tendency to reveal considerable distortion after heating, due to a small difference in case depth from one end to the other; they also would bend when lifted out, previous to quenching. These drawbacks have led to a determination to make improvements.

There has lately been developed at the plant of the Timken-Detroit Axle Co., Detroit, a rather unusual as well as efficient container. This company has been one of the first to overcome certain of the difficulties mentioned. Two objects were aimed at in designing a different container: (1) Vertical packing; (2) a receptacle to hold only one piece. The containers shown in the illustration were the outcome.

The aim in perfecting these containers was to develop the fabrication to the point where a life was secured which compared favorably with that of the cast metal container. A sheet metal alloy was finally selected, known by the familiar trade name "Rezistal No. 4" which contains about 26 per cent nickel, 18 per cent chromium and 2.50 per cent silicon. Those who have used the heat-resisting alloys claim that this alloy is superior to the nickel-chromium heat-resisting alloys used commonly in carburizing containers.

As can be seen from the illustration, these cylindrical containers, in sets of six, eight and up to fifteen units, are of welded construction, joined or held together by strips of the same metal welded to the several containers. Each one is provided with a lid. No little skill is required to weld this alloy but it can be done by experienced workers.

It has been demonstrated by the use of these containers, says H. W. McQuaid, formerly chief metallurgist of the Detroit company, from whom the facts were obtained on which this article is based, that not only would the work to be carburized come from a container of this design and material freer from distortion, but the required depth of case is attained in a remarkably short time. Work suitable to this container can be packed singly in each cell and it includes such parts as drive pinions, worms, pins, etc., as well as small gears and similar parts which can be stacked vertically.

The discovery was soon made that the old values of minimum work to compound ratio and the distance between this work and the container had to be materially revised. Such parts were packed in 4-, 6- and 8-inch containers so that they came within ¼ in. of the container's wall, with splendid results. Work was also packed in these receptacles so that barely 10 per cent by volume of the container was available for the carburizing compound, also with excellent results.

As to speed of carburizing reaction in these new containers, one consisting of eight 5-in. cylinders produced a case of 0.050 in. in 4 hr. and 30 min. total time in the furnace. A case of 0.030 to 0.040 in. under the same conditions has been obtained in 3 hr. total time in the furnace. These results compare favorably with those from any other known method of obtaining depth of case.

Another important advantage is that it greatly facilitates the direct quenching of those parts which are to be quenched from the container. The use of steels which permit direct quenching without increased distortion or grain growth has increased decidedly during the last two years so that the problem of handling work which must be quenched directly from the carburizing container has been no easy one.

The use of this new type of cylinder with individual covers permits the quenching of the work from each container without disturbing the others so that there is very little decrease in temperature from the first container emptied to the last one. By providing insulating shields, the hot containers can be comfortably handled, thus improving the entire operation of direct quenching. By means of certain fixtures it is possible to handle several pieces at the same time so that this type is not limited to work of special design but has large advantages for all varieties of work, especially small in size, such as differential pinions, worms, small gears of many designs, pins and so on.

Thus, the use of these individual carburizing containers with a minimum amount of compound and a maximum quantity of exposed surface for heating indicates that solid carburizers have approximately the same rate of penetration as any of the commonly used carburizing gases and also that the limitation of the solid carburizer, due to its relative slowness, is caused entirely by the insulating effect of the carburizing compound and the time required to heat the container itself. Where warpage is of importance the value of uniform heating, obtained in heating cylindrical objects and cylindrical containers, is a vital factor.

Those who have had experience with these new containers have found it possible to finish grind some parts before carburizing, and also, by using a case which does not have to have additional thickness for grinding, to obtain in this type of container a warpage which is within the finish grinding limits. In such circumstances, of course, an alloy steel is necessary which has been specially made, to reduce any tendency toward uneven quenching. Such a steel is obtainable from any of the leading makers of special alloy steels.

Sulphur as a Coolant

All old timers recall the trick of putting flour of sulfur (we spelled it sulphur then) into a hot bearing—and how it cooled it off, pronto. Now we are putting sulfur in steel to improve cutting qualities, and into cutting oils for a similar reason. In gun drilling and reaming, sulfur is especially useful in connection with a good mineral oil base. Four per cent of sulfur is recommended in hard drilling, reaming and tapping. For machining high carbon or alloy steels, high sulfur content is also advised. In some cases tool life has been doubled and even tripled. It's worth trying.

Cutting Off With Abrasive Wheels—Discussion

C. W. HINMAN

Cutting through a 1-in. bar in four seconds and other equally interesting abrasive-wheel stunts, as told by John R. Godfrey in *Seen and Heard* (*AM*—Vol. 78, page 390), recalls another method for cutting off heavy stock. I refer to the inclosed type of cold saw, a toothless steel disk about 30 in. in diameter and $\frac{1}{16}$ in. thick, running at about 3,000 r.p.m. and driven by a high-powered steam engine.

Forty-five years ago, railroad companies mounted such saws on flat cars, engines and all. They were taken along the line to cut off the battered ends of great piles of worn rails, which were afterward drilled for the track bolts. These were great days of excitement for the small-town boy when he heard the tremendous noise and saw the fireworks from the saw in operation.

The rails were clamped, two together, on a carriage fed toward the saw by power. A stream of water was pumped on each side of the saw near the cut, and the saw burned through the rails in a few seconds, leaving a surprisingly smooth, blue cut. The saws lasted a long time; in fact I have never seen one of them replaced. They must have stood up longer than any abrasive wheels would have done.

These burning-saws would sever any stock used in the average machine shop about as quick as the thought, and the reader may wonder why some modification of the idea never came into use for machine-shop work.

A Proposed Method of Measuring Circular Arcs Discussion

FRANCIS W. SHAW
Heywood, Lancashire, England

In an article under the title given above (*AM*—Vol. 78, page 18), C. W. Hinman says that to find the angle in degrees, minutes and seconds in each of 137 stepped divisions of a circle it is necessary to multiply 360 x 60 x 60 to find the number of seconds in the circle, divide the product by 137 and reduce the quotient back into degrees, minutes and seconds.

Had Mr. Hinman been accustomed to manipulating pounds, shillings and pence, he would not have suggested the necessity of such a method, which is a time-consuming operation. The answer can be found to the nearest second in less than 30 seconds by the following method:

```
137)  360 deg. (2 deg., 37 min., 40 sec.
       274     (2)
      ----
        86
  x     60
      ----
       5160
       4110    (30)
      ----
       1050
        959    (7)
      ----
         91
  x      60
      ----
       5460
       5480    (40)
```

The figures in parentheses need not be written down, but can be inserted direct in the quotient.

Another example is given where an arc less than a circle is divided by a whole number and a decimal, the quotient to be in degrees, minutes, seconds and decimal parts of a second.

```
                  deg. min. sec.  deg, min., sec.
  60.6)  237  59  49  (  3  55  38.432
  x 3    181.8
         -----
          55.2
  x          60
         -----
         3312
         +59
         -----
         3371
  x 50   3030
         -----
          341
  x 5     303
         -----
           38
  x          60
         -----
         2280
         +49
         -----
         2329
  x 30    1818
         -----
          511
  x 8     484.8
         -------
           26.2
  x 0.4    24.24
         --------
            1.96
  x 0.03    1.818
         --------
            0.142
  x 0.002*  0.1212
         --------
            0.0208 sec. remainder.
```

*The figures after the multiplication signs are not actually inserted in performing the operation. They are inserted here to show the derivation of the figures opposite them in the same lines. This operation required just under two minutes.

Characteristics of Worm Gear Hobs—I

ROLAND V. HUTCHINSON

From a thoroughgoing analysis of the tool forms giving best performance when hobbing worm gears, the author develops some practical data on methods of chasing and relieving

PRINCIPLES involved in the making of formed milling cutters may be extended to cover the geometry of worm gear hobs.

No general rules may be laid down as to the one and only way to design such hobs; each case must be considered on its own merits, and account taken of its own peculiarities. The bases herein discussed develop the limitations of the relieving process and the means of overcoming such shortcomings. These bases have always existed, but their effects and limitations have not always been recognized.

This presentation may be of assistance to those called upon to fill an emergency demand for worm gear hobs that will simultaneously produce first class work and have better than mediocre life.

The newly injected phenomena to be considered in this extension or branch of formed mill making are the superposition of relieving upon chasing motion, and the rotation of the workpiece about its own axis.

Hobs intended for use with tangential feed are treated.

The terminology established in the author's article "Relief of Form Milling Cutters" (*AM*—Vol. 77, pages 133 and 178) is continued in this article.

Terminology and Definitions

Professor Earle Buckingham's definitions of the several usually encountered helicoids will be used, and, in addition, the following definitions established:

A transverse section of a helicoid is a plane section normal to the axis.

A radial axial section is a plane section including the axis.

An axial section is a plane section, parallel to, but desaxé from the axis.

A normal screw helicoid is one having its generatrix normal to the axis.

A normal convolute helicoid is a convolute helicoid whose generatrix lies in a transverse plane and is tangent to its base circle therein.

Other necessary definitions appear at appropriate places in the context.

The Unrelieved Hob

The four basic characteristics of a hob, prior to relieving, are the geometrically independent variables:

L_w = lead of worm
L_g = lead of gash
N_w = number of threads in hob
N_g = number of gashes in hob

The helix angles of worm and gash are complementary at the radius z, where

$$z = \frac{\sqrt{L_g \times L_w}}{2\pi} \quad \ldots\ldots(1)$$

The worm helix angle at radius z, measured from the axle is

$$\beta_w = \arctan \frac{\sqrt{L_g \times L_w}}{L_w} = \arctan \frac{2\pi z}{L_w} \quad \ldots(2)$$

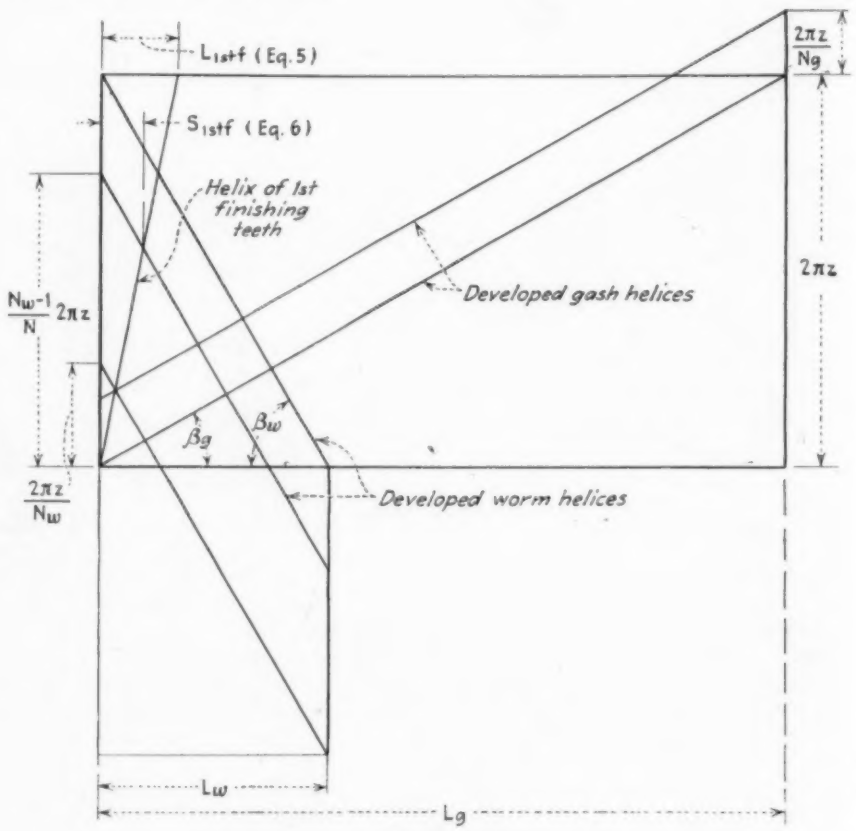


Fig. 1 Axial shift of 1st finishing teeth

$$L_{1stf} = \frac{L_g L_w (N_g - N_w)}{L_w N_g + N_w L_g} \qquad \text{Eq. 5}$$

$$S_{1stf} = \frac{(N_w - 1)(N_g - N_w)}{N_g N_w} \times \frac{L_w L_g}{L_w + L_g} \qquad \text{Eq. 6}$$

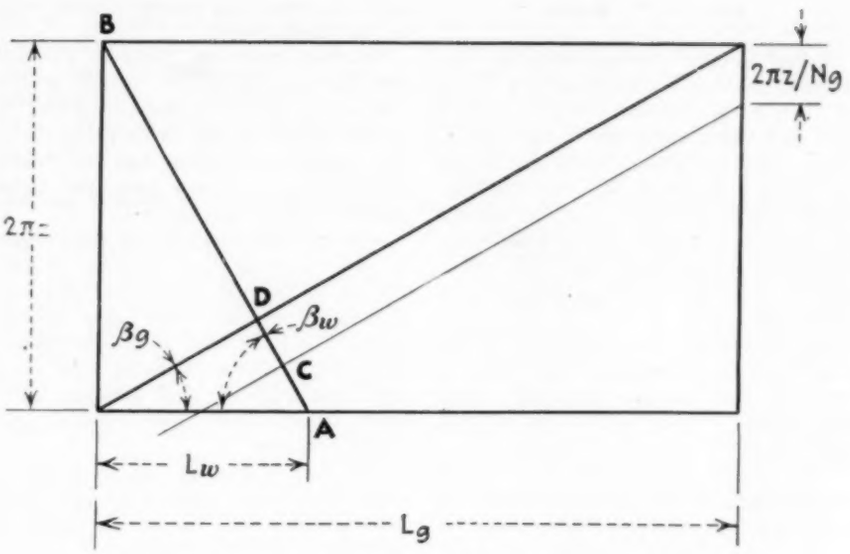


Fig. 2 Number of teeth relieved per revolution of workpiece in lathe

$$\frac{AB}{CD} = N_R = \frac{Ng}{Lg}\,(L_w + L_g) = Ng\,\csc^2\beta_w \qquad \text{Eq. (7)}$$

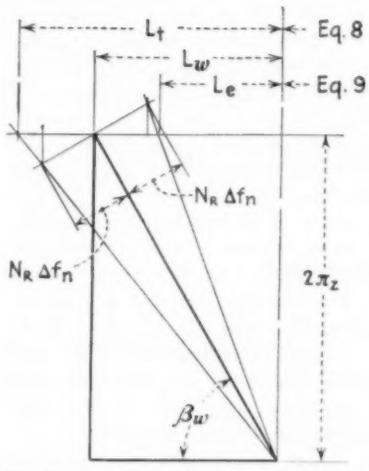


Fig. 3 Leads of entering and trailing flanks of uniformly graded roughing teeth

$$L_t = 2\pi z \sin\beta_w \left[\frac{L_w \sin\beta_w + Ng\,\Delta f_n}{2\pi z \sin^2\beta_w - Ng\cos\beta_w \Delta f_n}\right] \qquad \text{Eq. 8}$$

$$L_e = 2\pi z \sin\beta_w \left[\frac{L_w \sin\beta_w - Ng\,\Delta f_n}{2\pi z \sin^2\beta_w + Ng\cos\beta_w \Delta f_n}\right] \qquad \text{Eq. 9}$$

and that of the gash is

$$\beta_s = \arctan \frac{L_w}{\sqrt{L_s \times L_w}} = \arctan \frac{2\pi z}{L_s} \quad \ldots (3)$$

$$= \operatorname{arcot} \frac{2\pi z}{L_w} \quad \ldots (4)$$

Incidentally the several functions of β_w and β_s expressed in terms of L_w and L_s are as follows:

$$\sin\beta_w = \frac{\sqrt{L_s}}{\sqrt{L_w + L_s}} = \cos\beta_s$$

$$\sin^2\beta_w = \frac{L_s}{L_w + L_s} = \cos^2\beta_s$$

$$\cos\beta_w = \frac{\sqrt{L_w}}{\sqrt{L_w + L_s}} = \sin\beta_s$$

$$\cos^2\beta_w = \frac{L_w}{L_w + L_s} = \sin^2\beta_s$$

$$\tan^2\beta_w = \frac{L_s}{L_w} = \cot^2\beta_s$$

$$\cot^2\beta_w = \frac{L_w}{L_s} = \tan^2\beta_s$$

$$\sin 2\beta_w = \frac{2\sqrt{L_s \times L_w}}{L_w + L_s}$$

In the general case, N_w independent of N_g, the centers of the first finishing teeth are displaced out of a transverse plane and lie on a helicoid whose lead is:

$$L_{1\,ef} = \frac{L_s L_w (N_s - N_w)}{L_w N_s + N_w L_s} \quad \ldots (5)$$

and the axial extent of such displacement is

$$S_{1\,ef} = \frac{(N_w - 1)\,(N_s - N_w)}{N_s N_w} \times \frac{L_w L_s}{L_w + L_s} \quad (6)$$

When $N_g = N_w$ or integral multiples thereof, the above expressions reduce to zero, and Fig. 1 shows the relationships in diagrammatic form.

Further, when $0 < L_g < \infty$, the hob is helicoidally gashed, at $L_g = \infty$ it is axially gashed and at $L_g = 0$, it has become a Fellows cutter.

When helicoidally gashed, the number of teeth relieved per revolution of the hob in the lathe is:

$$N_R = \frac{N_s}{L_s}(L_w + L_s) = N_s \csc^2\beta_w \quad \ldots (7)$$

as illustrated by diagram in Fig. 2.

In the tapered roughing zone the teeth are of systematically varying height and width, and the semi-increment of tooth width measured normally to the worm helix line at radius z is taken as Δf_n. The lead of the trailing flanks (those remote from the entering end of the hob) is thus greater than that of the worm, and in terms of z and β_w is

$$L_t = 2\pi z \sin\beta_w \left[\frac{L_w \sin\beta_w + N_s\,\Delta f_n}{2\pi z \sin^2\beta_w - N_s \cos\beta_w\,\Delta f_n}\right] \quad (8)$$

and the shorter lead of the entering flanks is

$$L_e = 2\pi z \sin\beta_w \left[\frac{L_w \sin\beta_w - N_s\,\Delta f_n}{2 \times \sin^2\beta_w - N_s \cos\beta_w\,\Delta f_n}\right] \quad (9)$$

The increment leads $L_t - L_w$ and $L_w - L_e$ are unequal.

Expressed as axial dimensions, the axial semi-increment thicknesses of the teeth are

$$\Delta f_t = \frac{L_t - L_w}{N_R} \quad \ldots (10)$$

$$\Delta f_e = \frac{L_w - L_e}{N_R} \quad \ldots (11)$$

Equations 8 and 9, illustrated by Fig. 3, may be expressed in terms of the basic independent variables by substitution of the appropriate functional values of subsequent reduction.

The length of the hob blank may be arbitrarily established, dividing it into finishing and roughing zones. With tangential feed, the first finishers must feed through the whole zone of contact, so there is little point in making a long finishing region.

The length of the finishing group, reserving space for a minimum yet sufficient number of finishing teeth, depends upon N_w, N_g and the ratio of gash space to tooth length, the two latter dimensions being measured along the developed worm helicoid.

A suitable length of this portion is given by

$$l_f \approx \left[\frac{3}{2} + \frac{N_s - N_w}{N_s}\right] \times \text{axial pitch of worm} \quad \ldots (12)$$

This allows enough for $S_{1\,ef}$ of Equation 6 and for removal of preponder-

antly incomplete teeth remaining after gashing.

The axial length of the tapered roughing group varies between three and four times the axial pitch, the allowance increasing with number of threads in the hob. With this in mind, the length of the toothed blank becomes

$$l_t \approx \left[\frac{9}{2} \text{ or } \frac{11}{2} + \frac{N_g - N_w}{N_g}\right] \times \text{axial pitch of worm} \quad \ldots\ldots (13)$$

For initial consideration, the number of gashes may conveniently be taken as

$$N_g \approx 7 + \frac{\text{Pitch dia. of worm}}{\text{Axial pitch of worm}} \quad \ldots (14)$$

to the nearest integer, until finally checked by layout after determination of the necessary sharpening allowance and relief.

These last three equations are not immutable laws, but serve as guides in the preliminary proportioning of hobs.

The outside taper of the roughing zone may have about a 13-deg. included angle for the four times axial pitch length of zone, or may be set by making the first roughing teeth about a third full height.

The magnitude Δf_n is flexible and need not be identical for leading and trailing sides, and may actually in some instances be better to not be identical.

The roughing teeth are tapered for two reasons: first to reduce the duty imposed on the finishers, and second, to give a little leeway to avoid damage to the gear if some of the roughers are drunken.

If L_e and L_t, established by Equations 8 and 9, be found impracticable because of change gear limitations their values may be adjusted somewhat and the consequent values of Δf_n checked by the equations

$$\text{Adjusted } \Delta f_{ne} = \frac{2\pi z \sin\beta_w (L_e \sin\beta_w - L_w)}{2\pi z N_g - L_e N_g \cos\beta_w} \quad (15)$$

and

$$\text{Adjusted } \Delta f_{nt} = \frac{2\pi z \sin\beta_w (L_e - L_t \sin\beta_w)}{2\pi z N_g + L_t N_g \cos\beta_w} \quad (16)$$

Once L_e and L_t are approximately established, their corresponding influence on the relieving change gear train may be checked into by determining the N_R values for these leads, by substitution in Equation 7, thus

$$N_{RLe} = \frac{N_g}{L_g}(L_e + L_w) \quad \ldots\ldots (17)$$

and

$$N_{RLt} = \frac{N_g}{L_g}(L_t + L_w) \quad \ldots\ldots (18)$$

The N_w/N_g Ratio

Initial favorable consideration may be given to making N_w equal to or a factor of N_g when the numbers of teeth in hob and gear blank are prime to each other. When such relationship exists and $N_w \neq$ or is not a factor of N_g, then the furthest axially advanced group or thread of the hob is subject to intermittently heavier cutting than are the other groups with consequent increased rate of dulling.

As the highest common factor of the tooth numbers increases, this effect is reduced, and entirely disappears when the number of gear teeth is an integral multiple of the number of hob threads.

The N_w/N_g relationship then effects an increased or diminished convenience in certain operations in hob making. It is also influenced by necessary relief demanded by cutting conditions and by sharpening allowance permitted by the range of inaccuracy allowed in the gears produced.

From the standpoint of subsequent truing up in grinding operations inequality of N_w and N_g brings with it an apparent run out of the hob, since axial shift of the threads, together with the conical outline of the roughing group, gives this appearance.

Indicating corresponding teeth in each hob thread, with a radially fixed but axially movable indicator, when truing up for subsequent operations, results in the proper centering of this type hob becoming a possibility.

Hob Chasing Schedules

The first thing to establish accurately is the position of the centers of the first finishing teeth. The blank is turned cylindrical and a fine V groove turned on it at the chosen axial location of one of the first finishers. In the miller, geared to L_g, a fine tool is used to scratch N_g helices along the periphery, intersecting the peripheral groove. Starting at any intersection, a fine groove is chased with lead given by Equation 5, and hand as given by Fig. 1, opposite to that of the worm. The first intersections of the helics represent the centers of the first finishing teeth of each thread, and are center punched.

When $N_w = N_g$, the second screwline is not needed, as the first finishers all lie on the peripheral groove, which may be directly divided and the centers punch marked.

The hob is rough and finish chased to lead L_w, keeping the punch marks in the center of the tooth tips, and is then copper flashed.

The flanks are then rechased to leads L_e and L_t, where this method of tapering is incorporated, cutting continuing until the remaining copper extends only to the punch marks.

Starting from the furthest forward first finishing tooth, the outside of the hob is taper turned, establishing the tip heights of this group of roughing teeth. The remaining roughing tips are chased down using a broad tool, the lathe geared to either L_w, L_e or L_t.

The variable breaking of the corners of the roughing tips may be accomplished by the use of a chamfering tool in conjunction with the taper attachment, which by trial is set to remove maximum material from the nose teeth and none from the first finishers. The taper settings differ from entering and trailing corners.

The hob is now gashed to specification, care being taken that the tooth face helicoids split the punch marks on the tips of the first finishing teeth.

The peculiarity of the above scheme is that measurement of the threads is confined to the establishment of dimensions in the finished chasing to lead L_w, and the grading is done by working to settings and to line without subsequent calipering.

When the hob is robust enough to stand the extra gashing depth, the grading of the roughing teeth may be accomplished by taper chasing as now described.

The first parallel rough and finish chasing proceeds as before, and the hob is copper flashed.

The slope of the radial axial section of the worm helicoid at mid-tooth height may be obtained from the worm specification, and has the value tan a_m, measured from the axis.

The taper attachment angular settings with respect to the axis are:

for the entering flank arctan

$$\frac{N_R \ \Delta f_{ne} \tan a_m}{L_w} \quad \ldots\ldots (19)$$

and for the trailing flank arctan

$$\frac{N_R \Delta f_{nt} \tan a_m}{L_w} \quad \ldots\ldots (20)$$

The effect of L_e and L_t is produced by chasing the roughing section on both flanks with lead L_w, stopping as the cut runs out at the first finishing teeth. The flanks are chased separately, turning the work end for end to keep out slack in the leadscrew nut. The tips are tapered, the corners chamfered and the gashing is done as before.

The latter scheme is more suitable for use when making hobs of high axial pressure angle, as increase of this angle necessitates less taper in the chasing operation.

Either method permits arbitrary pregrading of the teeth independent of and

prior to the establishment of the desired relief.

The necessary technique in relieving operations is self-evident, so far as duplication of taper attachment settings is concerned.

Contact Zones of Hob and Gear

The contact zone figure of a worm and gear is defined as the projection into an axial plane parallel to both worm and gear axles, of the intersections of the ~~worm~~ helicoid and all its surface normals which cut the instantaneous axis through the pitch point, for all angular rotational positions of the worm.

The usual worm and gear combination has backlash, but the circumscribing helicoids of the tooth of a hob cause it to act with a finish cut gear as though it had zero backlash, and hence had simultaneous contact on both drive and coast flanks.

The contact zone figure for the finishing zone of the hob and a finish cut gear may be made either graphically or grapho-analytically, using the worm hob dimensions instead of the worm dimensions for one flank only. Then by 180-deg. rotation of this figure about its intersection of the projections of axes of hob and gear, and superposition, the envelope of the two figures gives the outline of the contact zone as a whole for finishing group and finish cut gear.

Generalization on shape of this figure is limited because of the many controlling variables.

The familiar bifurcated part increases in axial extent with increase in number of teeth in the gear when the pitch plane height is maintained constant, and diminishes as the pitch plane approaches the hob axis.

The axial length of the contact zone for the hob is twice the length of the longer half of the original contact zone diagram, measured from the intersection of the projections of the axes. This half length is also the distance past the gear center that the first finishing tooth must be fed for full generation of the gear.

Actually the finishing teeth, because of the presence of material to be removed by them, come into action a little sooner than the contact zone figure would indicate, the distance greater being approximately the axial hob tooth semi-increment Δf_{ae}.

Coated Electrodes in Arc Welding

J. E. WAUGH

Welding Engineering Department, General Electric Company

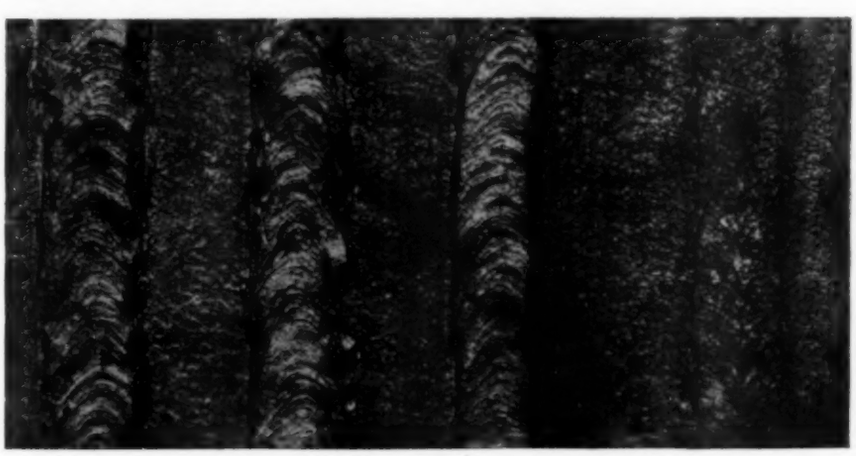
While weld metal and welded joints made with bare or lightly coated electrodes are usually satisfactory for static loads, they are lacking in ductility, impact, and fatigue strength and corrosion resistance. An effort to improve these qualities led to the introduction of the heavily coated electrode. Physical tests of weld metal deposited with this type of electrode produce results comparable to good quality mild-steel plate. The following table states comparative values obtained with the two classes of electrode:

Abstracted from a paper presented before the International Business Machines Club.

Comparative Physical Properties of Welds and Welded Joints made with Bare and Heavily Coated Electrodes

	Bare Electrodes	Heavily Coated Electrodes
Welded Joints		
Tensile strength in lbs. per sq. in.	50-55,000	Fracture in plate
Per cent elongation in free-bend test	10-15	30-50
All weld metal		
Yield point in lbs. per sq. in.	40-45,000	50-55,000
Ultimate strength in lbs. per sq. in.	50-55,000	60-70,000
Per cent elongation in 2 in.	5-10	20-30
Per cent reduction of area	10-20	35-50
Charpy impact in ft. lbs.	2-5	20-30
Density	7.70	7.82
Endurance limit in millions of cycles	10-15	20-30
Corrosion — (mild-steel plate as 100%)	30	95-100

These superior physical properties are due to the shielding of the molten metal while passing through the arc, thus eliminating the oxides and nitrides which have a great affinity for molten iron at the arc temperature, which is estimated to be approximately 3,500 C. The procedure in depositing weld metal with heavily coated electrodes, that of making the individual passes or layers relatively thin (of the order of $\frac{1}{8}$ in.) also results in an improvement of its physical properties because of the refining effect of each succeeding pass on the preceding pass. A still further improvement in ductility is accomplished by subjecting the completed weld to a strain relief anneal at 1,200 F.



The three welds at the left were made with various kinds of coated electrode; for the one at the right an uncoated electrode was used

How Smooth is Smooth?

Inspection of surfaces brings up the old question of "how smooth is smooth?" No one who produces a surface such as a cylinder bore, will admit it isn't smooth, especially if it is lapped or honed. Yet there is a very wide difference in the smoothness and wear of honed cylinders as piston ring makers know to their sorrow. They are spending a lot of money trying to educate motor makers and service men to turn out satisfactory cylinder surfaces, which differ amazingly as to oil consumption. On rotating work such as ball and roller bearings noise seems to offer a method of comparison. Gear tooth surfaces are checked in a similar manner in automobile transmissions. Men become expert in detecting different sounds and can tell what kind of defect in the surface produces different noises. This is a new phase of machine work that is receiving attention in many quarters.

When Are Machine Tools Obsolete?

H. D. HALL
Sharon Works, Westinghouse Electric & Manufacturing Company

When they fall short in adaptability, in productive capacity or in maintenance cost—as discussed here

MACHINE TOOL replacement programs have received favorable support during the past few years mainly because they propose scientific methods for turning a possible source of money waste into a positive source of profits. Many of the machine tools in use today have been found, through investigation and analysis, to be either inadequate for modern production or wasteful of the company's money.

The antiquated machine tool is obviously both of these, and while the surveys which have been made show that many machines in this class are still being used, the tendency is toward their complete elimination. The modern business concern with its various obligations can be satisfied with nothing short of the very best in equipment, in tools, and in methods.

My associates advocate the planning and scheduling of machine tool replacements along with the preparation of other predetermined items of expense. Resolved into programs they determine on the time for carrying out each phase of the work. Some of the programs are set to cover a period of five years, others are set at three years. They include plans and schedules for financing the programs and the methods for calculating the value of each of the factors connected with them.

At the risk of some repetition, it seems advisable to emphasize some of the factors that enter into these programs, especially those that have to do with the obsolete machine, because in the final analysis this machine forms the basis from which replacement programs are derived; that is, there would be no need for them were there no obsolete machine tools to replace. This will be better understood from what follows.

Adaptability

From the standpoint of machine tool adaptability the cost and output of each new design of product manufactured depends on the type, design, capacity and mechanical condition of the equipment used and the control of manufacturing methods. When there is only one article to be machined and the best machine tool available is provided for doing the work, adaptability may be said to have been satisfied.

But when the design of this article is changed, necessitating a physical change in operations, or the activity is increased, requiring a larger output than the machine is capable of doing, or is decreased to where the machine is no longer used, adaptability then becomes a matter of vital concern.

To make the point clearer, there are no advantages either in service or profits in continuing to use a shaper, just because one happens to have a shaper, on work that can be done better and more economically on a milling machine which one may not have. Neither is it profitable to use two or more machines on an activity which has been found through investigation and analysis to justify the installation of a single manufacturing unit. Sooner or later there will be an accounting, and in the meantime profits may be lost and the service to customers seriously impaired.

During the last decade, equipment, tools and methods have been given specialized attention both in specification and application, with the result that there has been a gradual re-routing of operations. Work that was once assigned to the engine lathe is now given over to the turret lathe or to automatic machinery where it is not only done as well but at much less cost.

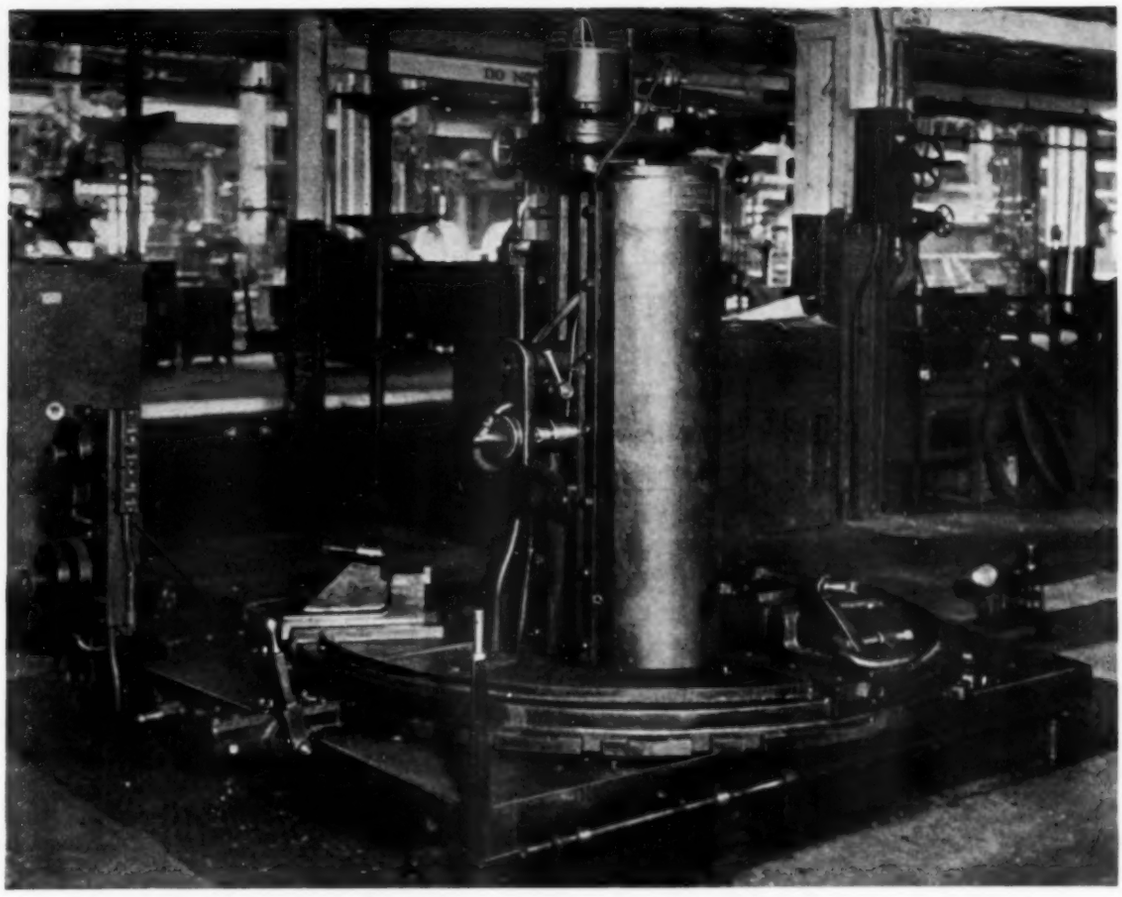
The grinder is used for work that was once done on a planer, the milling machine is used on work that was previously machined on the shaper. The special machine is designed to do a combination of operations that were previously done on several types of machines.

This shifting of operations from one machine to another proved among other things that: (1) there is one best method for doing work; and (2) the old method should be discarded just as soon as it is found to be inadequate. Now in order to make sure that this practice was being followed, modern management set up a system of control which specified where each operation was to be done: that is, it specified the equipment, tools and methods to be used, and the time allowed for doing the work.

Making Machines Obsolete

Under this arrangement, equipment, tools and methods have fallen into certain classifications, and in point of adaptability productive hours have by this procedure been taken away from some machines and added to others until it has come to the point where some machine tools are made obsolete. For example, suppose the milling machine mentioned previously were purchased and installed; is the shaper obsolete?

It would seem that it is, so far as these operations are concerned, as it will no longer be needed for them. This shaper does not now lend itself to the economical manufacture of the product, nor to the good of the service, so that regardless of its productive capacity or mechanical condition, it is replaced by a machine that is more adaptable to requirements.



Introduction of the fabricated motor frame has made it expedient to change many of the methods for manufacturing motors. This special drilling machine drills and spot faces the holes around the frame from the inside. The previous method was to do the drilling from the outside of the frame on a radial drill and then to do the spot facing on the inside of the frame on the same machine but with a special attachment. The advantages of the new set-up can be easily appreciated

Of course, the shaper may be mechanically good in every detail. Here again, proper analysis of the department or plant in which the machine was used may reveal that it may be used to replace still another machine which has also been found through change in design of the product, or methods, or the mechanical condition of the machine, to be unadapted to economical manufacture. Companies manufacturing a reasonably large variety of products obviously have the greater opportunity for this practice, which if supported by adequate planning will save many dollars in the manufacturing cost of the completed products.

Productive Capacity

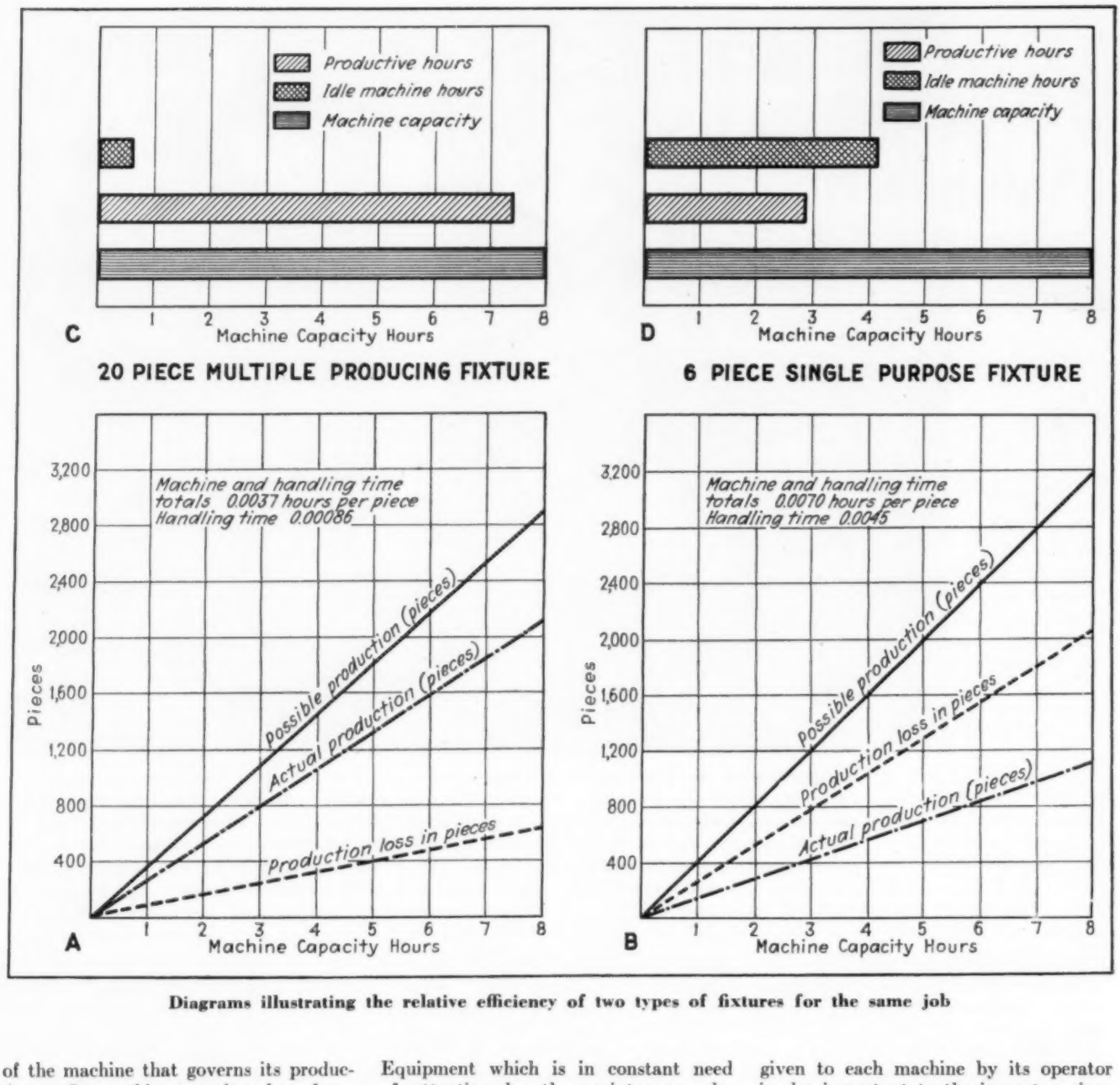
Productive capacity is the second major factor of concern in the determination of the obsolete machine. A machine must be capable of giving at least as much production in a given time as any other machine would give under similar conditions. Machine values depend upon results. How old the machine may be matters little. What it will do continuously counts everything.

Every machine tool has a maximum productive capacity. Whether this is used advantageously depends primarily on (1) the activity of the product; (2) the kind of tools and fixtures used; and (3) the accuracy required. Perhaps the introduction of a few curves at this point will serve to bring out the relative importance of these factors more clearly.

The graphs in the illustration show the relative importance of a jig or fixture design by the number of pieces actually produced with the jig or fixture in a given time. In this particular example the two curves cover the same job. The block diagrams at *C* and *D* give a comparison of the productive and idle machine time when making the pieces shown on the graphs at *A* and *B*.

This phase of machine tool performance, however, involves further the determination of the logical and most economical sequence for the performance of operations, and the selection of the best available methods for manufacturing, with special attention being given to the accuracy with which each part must be made. These factors have a very important bearing on the investment in tools and equipment, which in turn is reflected in cost. Accuracy is an important consideration, as the productivity per man or machine hour is in general inversely proportional to dimensional limits and tolerances. Excessive costs from this source are a reflection of the care that has had to be exercised and the necessity for a high grade of labor, equipment and tools; and of high maintenance to keep them in condition to produce parts within the required accuracy.

Thus we see the bearing that the design of the product, activity, tools and accuracy have on the productive capacity of a machine tool. At the same time it is also recognized that they contribute nothing that can go beyond this capacity, or to put it another way, it is the capacity and mechanical condition



Diagrams illustrating the relative efficiency of two types of fixtures for the same job

of the machine that governs its production. Once this capacity has been reached, there remains then the task of knowing when it has been exceeded by a more modern design. This is usually accomplished by the simple process of comparing the old with the new and translating these facts into terms of dollars and cents.

Maintenance

Maintenance as the third factor in determining the obsolescence of machine tools embodies these problems: (1) repair frequency and cost over a predetermined period of time; (2) effect of breakdown on production schedules and production costs. In each department of each industry with its own type and conditions of equipment a complete solution of these two problems is essential. Equipment which is in constant need of attention by the maintenance department is more often a liability than an asset.

Moreover, the repair costs resulting therefrom if accurately compiled may show that they were greatly in excess of the worth of the equipment. At all times a company must safeguard its cash position, and the success or failure of any plan designed to accomplish this as it pertains to machine tools can be judged only from periodic surveys of this equipment, and the effect the plan has on the company assets.

The systematic inspection of equipment is primarily for the purpose of detecting anything that might cause a breakdown or failure, and thus allow for steps to be taken to insure continuous and satisfactory performance of machines as far as possible. The care given to each machine by its operator is also important to the inspector, since in many cases serious damage may be averted by the simple process of issuing adequate instructions.

But with all of the care and attention that can be given to machine tools they eventually wear out, and the concern which is in the position to know positively when that time has arrived will obviously profit the most. It requires very little mathematical calculation, as production delivery records, production cost records and repair bills usually contain the required information. It is, however, preeminently important to interpret and gage their significance correctly: (1) as to whether production deliveries are being made satisfactorily; (2) whether production costs indicate maximum efficiency performance from both men and machines;

This milling machine is a recent replacement of a machine on which the maintenance cost was found to be in excess of the worth of the machine. This setup is used for machining controller parts

(3) whether the maintenance costs are kept at a minimum; and (4) as to how much improvement is possible.

The satisfactory answer to these questions can be made only by establishing standards of efficient performance, and then comparing the present performance with that of the standard. Without this standard, management cannot be sure that the performances of men and machines are as efficient as they should be. With the establishment of standards of performance, however, there is given to management the means of control essential to the performance of the machines.

Every business and every department in a business should, therefore, set up its clearly defined objectives. These should be carefully worked out in detail and clearly stated in writing, and they should be reviewed from time to time to make sure that they are still adequate. Better methods, better performance and lower manufacturing costs are fundamental requirements of business that never change.

Better methods should, and usually do, pave the way for better employee performance, and this in turn makes for lower manufacturing costs. The modern machines with their centralized control, quick change gearing and high spindle speeds, placed in the hands of a competent and efficient workman certainly offer not only a better method but a less costly one than can be expected from any other set-up of less modern design.

On the other hand, the buying of additional equipment means a greater outlay of capital and an increased cost which must be absorbed by increased production, so that a better way of using the equipment already provided often results in as great savings as does the installation of an entire set of machinery, and at much less cost.

Boring Attachment for a Lathe—Discussion

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Referring to the article by Eugene L. Soltner under the title given above (*AM*—Vol. 78, page 289), I cannot understand why the author went to so much trouble and expense to fit up the tailstock when feeding could have been better done by the carriage.

During the World War I was responsible for boring the holes in recuperators for heavy howitzers. With a lathe having a central lead screw 4 in. in diameter and ¾-in. pitch; with a pump delivering coolant to the tools; and with carriage feed, we were able to leave the job to take care of itself for hours on end.

The carriage feed is the more dependable and the only need for the tailstock would be as centralizing means for the long boring bar. On account of its limited range, feeding by the tailstock spindle would mean that every little while the tailstock and its appurtenances would have to be moved along the lathe bed, whereas with carriage feed no shifting would be necessary.

I would have been greatly interested had Mr. Soltner given a description of his cutting tools. He states that rough drilling 10-in. holes was done with a flat drill in the usual way. What is the usual way implied? It is my opinion that with such a cutting tool, adequate for the work, the way would be rather special and could not be classed as usual in its generally accepted meaning. A description of the cutting tools might be of considerable assistance to all engaged in such work.

Sub-Zero Fits

The familiar property of expansion and contraction with rise and drop in temperature of metals is frequently utilized in binding a shaft or pin in a collar or socket by a shrink fit. With most metals, an oversize of the shaft of 0.001 or 0.002 in. per in. of diameter can be accommodated by heating the encircling member before the two are assembled. The converse method of contracting the pin or shaft by cooling it in liquid air or "dry ice" has received only brief mention, probably on account of the supposed commercial impracticability of the operation. The widespread availability of solid carbon dioxide as an easily transported refrigerant has put this method on a more practicable basis.

As described in a paper by W. H. Swanger, at the June meeting of the American Society for Testing Materials, some work was recently completed at the Bureau of Standards on the axial slip of shrink fits made by cooling 1-in. diameter cylindrical pins to —80 C (—112 F) in dry ice and inserting them into rings which were about 0.0015 in. smaller than the pins when both were at room temperature. Three combinations of pin and ring were used; a brass pin and brass ring; a brass pin and steel ring; and a steel pin and steel ring. The maximum resistance to axial slip developed after a small amount of initial slip was 1,430 lb. per sq.in. of contact area in the all-brass unit and 6,050 lb. per sq.in. of contact area in the all-steel unit. The higher resistance in the steel unit was chiefly because seizing between pin and ring occurred to such an extent that particles of steel were torn bodily from the pin. In the brass unit no such seizing occurred. The maximum resistance developed between the steel ring and brass pin was 2,100 lb. per sq.in. of contact area, and the pin was visibly scored by the steel ring.

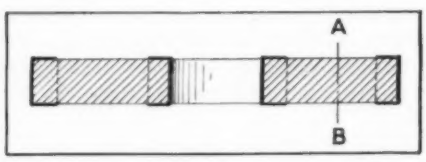
Rest Cure for Worn Gages Discussion

A. L. DE LEEUW
Consulting Engineer

THIS article is not written to explain why the 4-in. plug that M. P. Dalton mentions (*AM*—Vol. 78, page 149) acts as it did, but rather to show that he should not be surprised when 4-in. plugs choose to do queer things. Of course the plug was hardened, and that means that it was first heated and then quenched. Reading these two terms, heating and quenching, just casually, there seems to be little reason to suspect that either of these two operations may be more complicated than can be expressed by these simple words.

The accompanying illustration shows a flat disk 4 in. in diameter, ½ in. thick and having a 1-in. hole. Let us see what happens when we heat such a disk. It is supposed to be suspended in a furnace, the inside of which is of absolutely uniform temperature, a condition that does not always exist. However, to make the illustration as simple as possible we will suppose that there is such uniformity and that the disk is suspended in such a way that every part of its surface is subjected to that temperature. The writer does not know how to make such a suspension, but again this condition is assumed in order to make the example as simple as possible. Dotted lines are shown in the illustration ¼ in. away from the outside and inside diameters. We will consider how the regions between the dotted lines receive the heat from the furnace. The outside region has an outside diameter of 4 in., an inside diameter of 3½ in. and a thickness of ½ in. Its volume is $\frac{15}{4} \times \pi \times \frac{1}{4} \times \frac{1}{2} = \frac{15}{32}\pi$. The area exposed to the heat consists of three parts, the total of which is $\frac{15}{4} \times \frac{1}{4} \times 2\pi + 4\pi \times \frac{1}{2} = \frac{15}{8}\pi + 2\pi = \frac{31}{8}\pi$. The ratio between area and volume expresses the rate at which this part of the disk is being heated, and this ratio is $\frac{31}{8}\pi \div \frac{15}{32}\pi = \frac{124}{1} = 8\frac{4}{15}$. The volume of the region around the hole is $\frac{5}{4}\pi \times \frac{1}{4} \times \frac{1}{2} = \frac{5}{32}\pi$, and the area exposed to the heat is $\frac{5}{4}\pi \times \frac{1}{4} \times 2 + \frac{1}{2}\pi = \frac{5}{8}\pi + \frac{1}{2}\pi = \frac{9}{8}\pi$. The ratio between these two, that is, the rate at which this region is being heated is $\frac{9}{8}\pi \div \frac{5}{32}\pi = \frac{36}{5} = 7\frac{1}{5}$.

This shows that not all parts of the disk are being heated at the same rate. The outside receives more heat per cubic inch than does the inside, and the inside again receives more heat per cubic inch than does some region in the neighborhood of the broken line. As a result there is a constant flow of heat from both outside and inside toward the line *AB*, and if finally the region at *AB* has received sufficient heat to bring it to the same temperature as that of the inside region, then there will be a further flow of heat from the outside toward the hole. This condition will remain until the entire disk has acquired the temperature of the furnace.



When suspended in a furnace having a uniform temperature, not all parts of this disk will be heated at the same rate

If things are so arranged that the furnace has exactly the right temperature to which the object should be heated, and if that object is left long enough in the furnace to become uniformly heated throughout, then we do not need to consider the conditions mentioned above. But if the furnace is of a higher temperature than that desired for the object, then there will be a difference of temperature between the regions near the outside and those near the hole.

This much for the heating end. As to the quenching, that is even more complicated; for leaving the object in the bath until it has cooled completely does not do any good.

The object must be heated to a temperature where the metal becomes fluid (not liquid). To become liquid would mean that it would behave like water, that is it would assume the shape of the receptacle in which it is held. To become fluid simply means that the molecules have a sufficient degree of freedom to group themselves into new patterns. So soon as the temperature has dropped below the critical point, the grouping of molecules become static or stable. Further cooling does not alter the condition.

Now, if a thick object such as a 4-in. plug is quenched, there is a flow of heat from the entire object toward the medium of the bath. Almost at once the outside becomes cool enough to stabilize the crystal form, but the inside is still fluid. This heat flowing from the inside toward the outside keeps the outside hotter than the bath, but not hot enough to retain it in the fluid state. We have here a condition similar to what happens to a casting where thin sections are adjacent to thick ones. There is a pulling away of the metal. In the case of a piece of steel that is being quenched there is no danger that shrink holes will be formed, but stresses are set up in the metal. Such stresses may actually cause breakage where the piece is not properly designed to resist them. But whether or not breakage occurs, the stresses are there and they may cause all kinds of final results.

Delayed Action

However, while such results may not show themselves for a long time, a shock or pressure may cause deformation or shrinkage, or expansion of some part. Such a piece may be left alone for a long time, after which it may be found to have grown, or perhaps shrunk. It all depends upon the dimensions and shape of the piece and upon the way it was heated and quenched. Without knowing the complete history of the piece, it would be impossible to predict what might happen, and even knowing all this it would require a man who is extremely well versed in the art of heat-treating to predict within any degree of assurance what one might expect.

However, difficult as it may be to make such predictions, there are certain things that one can avoid. The writer would not like to be responsible for the behavior of a piece of hardened steel 12 in. in diameter and 12 in. long. Neither would he like to be held responsible for a plug 4 in. in diameter if it were made solid. It would seem to him that the thing to do is to make a hollow plug—4 in. outside diameter and 2 or 2½ in. inside diameter. Much of the trouble that one may expect with a solid plug would be avoided in this manner.

Much more could be written on this subject, but the writer merely wanted to call attention to the fact that heating and quenching are not as simple as they seem to be.

Cost Keeping in the Small Shop

FRED H. COLVIN
Editor, American Machinist

THE REASON why many systems fail is because people expect them to run themselves. This is particularly true of the small shop. While the perfect automatic cost system is yet to be invented, the one shown herewith has worked out well in a small shop and is worth looking over.

While cost keeping may be said to be one of the great problems in all industries it is particularly perplexing in the small shop, where clerks are a luxury and most of the timekeeping devolves on the boss and the men. Direct costs are of course based on labor and material, and while these are not always as simple it is the indirect expense that gets the small shop into difficulty.

Then, too, the question of how a bill shall be rendered is well worth careful consideration, because the psychology of the one who is expected to pay it must be taken into account. Many demand an itemized bill, and this extends up to one of the wealthiest men in the world, who requires an itemized account from his physicians and specialists.

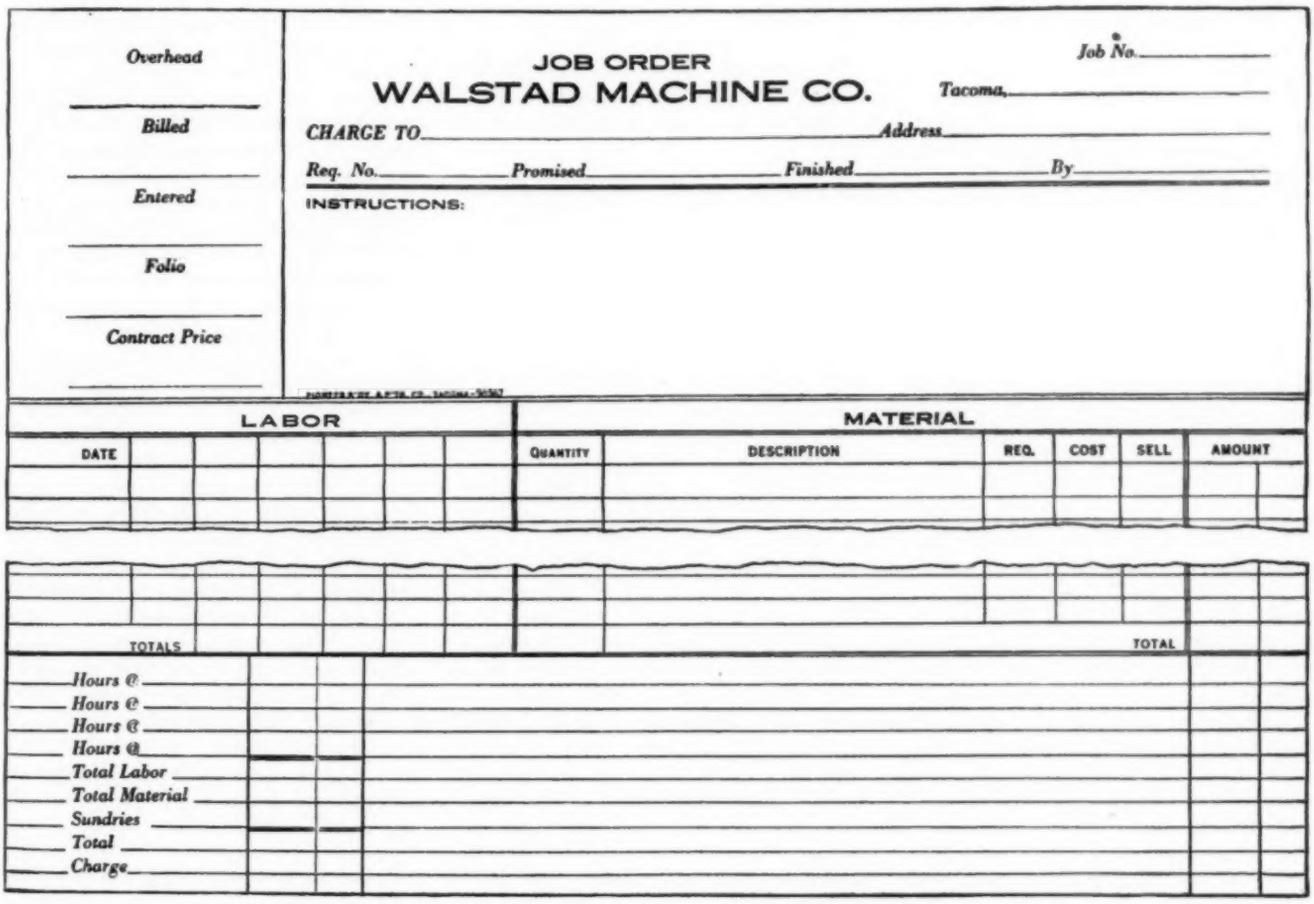
There are two sides to this question, however, and some are opposed to it for various reasons. You have a certain job to be done—it costs you so much money, using necessary material and labor. Why, say some, itemize every bolt and screw? If there is to be complaint as to cost it might just as well be as to whether a new bolt was needed as to question its cost.

It often happens that a job needs a single bolt which ought not to cost over five cents at any hardware store. And yet that bolt may have cost the small shop man fifty cents or more, because he had to send a man or boy downtown, or elsewhere, to get it. Yet if anyone sees a charge of fifty cents for a five-cent bolt the wail against the profiteer will be loud and long. Of course the extra forty-five cents might go in as labor, but it really belongs in overhead, which few small shop men know how to figure.

Some shops have come to believe that the most satisfactory method is to bill something like this: To reboring cylinders, replacing four piston rings and two piston pins; grinding valves, cleaning carbon, assembling and tuning motor—$43.65, or whatever the charge may be.

But whatever the method of charging or billing the small shop needs a cost-keeping system, and the one used by A. N. Walstad of Tacoma, Wash., seems to fill the bill.

First comes the "Job Order Sheet," Fig. 1, which is 11¼x10¾ in. and fits into a loose leaf binder. This is the office record, on which is noted each day the time and material which have been charged against this particular job. These items come from the individual time slips which are shown in Fig. 4.



Overhead
Billed
Entered
Folio
Contract Price

JOB ORDER
WALSTAD MACHINE CO.
Job No.
Tacoma,
CHARGE TO. Address
Req. No. Promised Finished By
INSTRUCTIONS:

LABOR

DATE							
TOTALS							

MATERIAL

QUANTITY	DESCRIPTION	REQ.	COST	SELL	AMOUNT	
				TOTAL		

Hours @
Hours @
Hours @
Hours @
Total Labor
Total Material
Sundries
Total
Charge

Fig. 1—The job order blank that fits a loose leaf binder

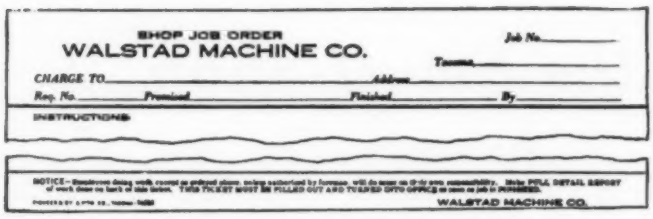

SHOP JOB ORDER
WALSTAD MACHINE CO.
Job No.
Tuesday,
CHARGE TO
Address
Req. No.
Promised
Finished
By
INSTRUCTIONS
WALSTAD MACHINE CO.

Fig. 2—This 5x8 order slip goes into the shop with instructions as to materials and delivery

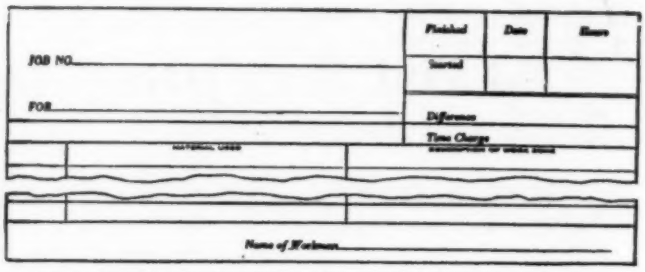

JOB NO.
FOR
Finished
Date
Hours
Started
Foreman
Time Charge
Name of Workman

Fig. 3—The back of Fig. 2 on which the workman makes a full report of the job

The "Shop Job Order," Fig. 2, goes into the shop. This gives the number of the job for the time slips, tells them briefly the conditions as to delivery and contains any special instructions which may be necessary. The workman makes a full report on the back of this slip for the information of the office. This order slip is 5x8 in. for card files.

The "Daily Time Card," Fig. 3, is a 3x5 card and covers the time spent each day in the shop. It is stamped on time clock, "in" and "out" in the usual way, with allowance for overtime in case more than eight hours are worked in the shop.

The last form is a 5x8 in. card and is the "Individual Time and Material Slip." It is stamped in at the same time the man starts to work in the morning and is only used for one period of work on one job. If the workman works an hour on the first job he stamps his time in and out, and makes out a new card for the second job. If he works on the same job four times in one day he has a card for each time, four cards in all. When he stamps "out" on a card he is through with that card and it goes into the office.

If he worked on one job all day he would have two cards, one for each time he stamped in and out. In any case the sum total of his various time and material slips must equal the time charged on his daily time slip, Fig. 3.

One of the leaks in a small shop is in overlooking to charge for material used, especially small stuff such as screws, solder, etc. When these individual time and material slips come to the office they are looked over to see that all material has been charged. If it is a job of soldering there should be a charge for solder and acid or paste, and so on. These small items count up.

When a job is completed all the individual time and material slips, Fig. 4, are taken from the card index file and filed away with the shop job order, Fig. 2. The large job order is also removed from the daily job book and filed away in a loose leaf binder for future reference.

The daily time card for each man is filed away every day after the time has been entered in the time book from which the pay roll is made up. This system, with only four different blanks,

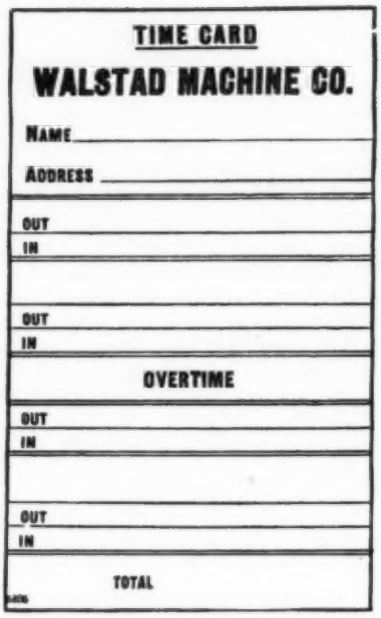

TIME CARD
WALSTAD MACHINE CO.
NAME
ADDRESS
OUT
IN
OUT
IN
OVERTIME
OUT
IN
OUT
IN
TOTAL

Fig. 4—Daily time card that is easy to stamp or fill in by hand

has worked out very well in practice under varying and trying conditions. It is so much better than anything used before that Mr. Walstad wished others to benefit by it, should it seem to fit into their business needs. Of course, different kinds of business will require different forms or routine, but the principle remains unchanged.

Prices of Spare Parts Discussion

GILBERT G. COOMBS

Your editorial under the above title (*AM*—Vol. 77, page 500a) induces me to offer the views of a consumer who, while endeavoring to realize the difficulties with which the manufacturer is confronted, has made some effort to analyze specific cases of exorbitantly priced replacement parts. Our experience has proved that some machine builders furnish parts at a perfectly equitable price, making their just profit without arousing the ire of their customers. Others demand a price which leaves no doubt in the purchaser's mind that he is being gouged, and the feeling is by no means conducive to further business.

A certain machine was recently brought into our plant repair shop for overhaul, where it was found necessary to replace several parts. The manufacturer offered these parts at a price which made us wonder if an entire new machine would not be cheaper. We were satisfied that the quotation was far in excess of the actual value of the parts and determined to make the parts in our own shop. The cost of these parts, patterns included, was almost 50 per cent lower than the factory price.

Similar experiences with this manufacturer prompted us to question his representative. He admitted that the prices were unreasonably high, and naïvely explained that his company preferred to sell us a new machine rather than furnish spare parts for the old one.

We once purchased a centrifugal pump impeller from a well-known pump manufacturer, and promptly questioned the exorbitant invoice which followed. We were informed that the costly engineering skill in design was chiefly responsible for the high price. This was hardly a satisfactory explanation, since such costs must have been spread over a large number of units and replacement of the part was a rare occurrence. Investigation showed that this company charged unreasonable prices for all replacement parts, regardless of size or cost of design.

While appreciating the fact that parts seldom called for are of necessity more expensive, there is something radically wrong when a repair shop, with its meager equipment, and consequent slow methods, can produce machine parts for one-half the price demanded by the builder of the machine. Even with specialized machinery a customer expects—and is entitled—to have spare parts available at reasonable cost. And since some manufacturers successfully fulfill this obligation, one is led to blame poor management when excessive prices are demanded. Maintenance costs, today more than ever, are vital factors in the selection of new machines, and the attitude of the builder in this matter is bound to affect his sales.

EDITORIALS

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ESTABLISHED 1877

McGRAW-HILL PUBLISHING COMPANY, INC.

K. H. CONDIT F. H. COLVIN

EDITORS

Railroad Modernization

MANY AN industry would be better off if it had a coordinator of the type of Joseph B. Eastman, Federal Coordinator of Transportation. As proof of this statement we offer in evidence a list of "important mechanical and metallurgical questions" that have arisen in connection with his studies of freight and passenger traffic. Here they are:

"Use of new metals and alloys to reduce the excessive weight of equipment and the excessive maintenance necessary to avoid corrosion.

"Use of non-harmonic springs, selective draft gears, high-speed brakes and wheels to avoid unnecessary shocks and damage to lading.

"Use of all-purpose freight cars designed to handle any kind of freight and capable of being loaded or unloaded from any one of the six sides.

"Use of cars which will run on the rail and highway interchangeably.

"Use of containers designed for the needs of all sorts of commodities.

"Use of truck bodies interchangeable between the chassis of a rail car and a highway truck.

"Use of new forms of refrigerating devices.

"Use of new-type steam, gasoline, diesel or electric locomotives, with varying types of transmission."

To help in finding the right answers to these questions Mr. Eastman has appointed a mechanical advisory committee to cooperate with his Section of Transportation Service. The members of this committee are all men of standing and ability. Their first report will be awaited with interest. When they get through with Mr. Eastman's questions they may well try to discover why railroad repair shop executives are forced to limp along with tools and equipment older than the oldest locomotives.

Now Is the Time

JUST BECAUSE the Wagner Bill has not become a law and a steel strike is not likely in the immediate future there is no reason for management to feel that nothing more need be done about industrial relations. Unless your plant has a good organization which includes the great majority of your employees, this is the time to give careful consideration to the building of such a body in your organization.

Recent elections in large plants indicate a desire for plant unions rather than any of the large national bodies. But unless such plant organizations exist and are really representative, giving the employees a voice in the conduct of such functions as vitally concern them, we are inviting trouble. Company dominated unions practically force employees to look to the national unions for aid. Real plant unions, however, in which representatives of both management and labor discuss problems before they become grievances, have done and can do much to improve relations in every way. There are shining examples where such organizations, or works councils, not only maintain harmony but do much to improve both quality of product and efficiency of methods.

Now is the time, before the convening of the next Congress, to establish industrial organizations that will give employees adequate representation. These organizations can be patterned after any one of a number of works councils that have proved successful over a period of years, and have shown conclusively that the men have no desire to run the business or to dictate details of management. They do, however, want to be recognized as an important part of the business and to have a means provided for discussing their problems. Those who neglect the opportunity now presented may regret their apathy later.

Automobile Peaks

EVERY ONE connected in any way with the automobile industry suffers in some degree from the abrupt seasonal peaks and valleys of its sales curve. A study of the production statistics shows that in eleven of the last fourteen years the peak came in the second quarter, and in six of those years the peak month was April. December production, on the average, is half that of May; November and January are almost as bad.

Production peaks, with their evil effects on employment steadiness, are obviously synchronous with sales peaks, and production valleys are likewise attributable to slack markets. Equipment purchases are similarly timed to be made just before production speeds up, and the effect on equipment builders and their working forces is distinctly unfavorable.

Critics of the industry have demanded that the production peaks and valleys be leveled. The leaders of the industry insist that leveling is impossible until public buying habits change. They point out the obvious fact that people usually buy cars in the spring. They also remark that new models, for the most part, are introduced at the New York show.

These facts are indisputable but they testify to

a traditional handicap in an industry that has always boasted of its freedom from hampering traditions. Just because people bought touring cars at the opening of the touring season, in the days when all automobiles were pleasure cars, is no reason why they should continue to concentrate their purchases of the general utility vehicle of today in the open season.

The industry is considering abandonment of the January shows in order to stagger the introduction of new models, but in view of the enormous volume of free advertising that has always greeted these shows the financial soundness of the step may be questioned. On the other hand, if the industry really tried to change the buying habits of the public it could probably produce a considerable effect. It could change its open roadster, pretty girl, wide open spaces advertising copy to something more in keeping with present uses of automobiles, and it might well adopt a sliding scale of discounts for the present slack months that would operate in the same way as the anthracite coal discounts that prevail in the second quarter of the year.

If there is any doubt of the efficacy of such discounts just look at the improvement in sales that has followed this year's June cuts in small car prices. Under present conditions many of us would rather buy a tried car at a price we can pay than wait for the new model at a higher price. Anything that offers a chance of leveling automobile sales peaks and valleys is worth trying.

.CHIPS.

Washington—On the eve of his vacation President Roosevelt puts the steel dispute up to Miss Perkins . . . Relief agents planning great migration from drought areas . . . President allocates $150,000,000 of $525,000,000 relief appropriation . . . Signs Housing Bill, whereupon lumber dealers announce 10 per cent cut in lumber prices . . . Appoints J. A. Moffett, Standard Oil Official, to administer it . . . Names members of Stock Exchange Control and Communications Commissions and appoints new Labor Board to succeed Wagner Board . . . Acts on 200 bills and leaves on cruiser Houston.

Foreign—von Papen's criticism of Nazi radicals, suppressed by Goebbels, gets open support of von Hindenburg and is interpreted as plea for monarchy . . . Goebbels says nobody but a Nazi can criticize Hitler régime but affairs seem to be approaching a crisis as failure of Nazi promises strikes home . . . Hitler stifles rebellion of storm troop leaders . . . Executes a score of them and also "eliminates" von Schleicher, von Bose and Klausener . . . Cuban commission votes loans of $60,000,000 to Machado government illegal . . . British experts call for 20 new cruisers in preliminary discussion with American experts and are likely to get the American approval which was not forthcoming in 1927 and which broke up that conference . . . A.B.C. of Cuba feeds its critics castor oil, Cabinet quits . . . Loss of gold coverage by German Reichsbank leads consumers to lay in stocks of goods "just in case" . . . British war plans involve making a forward defensive zone of Holland and Belgium, doubled air force . . . Albania demands retirement of Italian fleet on surprise visit to Durazzo . . . Trade boycott is making it almost impossible for German industry to get needed raw materials.

Finance—Federal Reserve Board and RFC announce rules for extending working capital loans to industry, restricted to maximum of $500,000 and "sound" borrowers, and barring use for betterments, improvements or additions . . . Abrogation of gold clause in bonds held valid by U. S. District Court Judge Faris in St. Louis . . . Secretary Morgenthau promises to buy silver at home and abroad "at a reasonable price" . . . Santa Fe resumes dividends after two years . . . Union Twist Drill does likewise . . . Canada votes down Keynes managed currency plan for its central bank, will stick to gold . . . Harriman gets 4½ years for false entries in books of his bank . . . P.R.R. will pay a second 50-cent dividend this year . . . National Cash Register resumes common stock dividends missing since 1931.

Industry—Philadelphia Naval Aircraft Factory to be expanded with $2,700,000 appropriated under Deficiency Act to meet terms of Vinson Naval Building Act which calls for 1,184 planes to equip the new warships . . . Westinghouse books million-dollar steel mill order . . . Final vote of steel workers brings out 90 per cent of the employees and shows 3 to 1 against strike . . . Armed mob of mill hands out of work through closing of Harriman Hosiery mill chases union organizer out of town.

Trade—Foreign trade down in April in both directions but still ahead of April, 1933, record . . . General Motors reports smaller attendance at 1934 60-city display, but a 42 per cent increase in car sales over 1933 and a 177 per cent increase in truck sales . . . France sets up new and much tighter restrictions on imports of U. S. films . . . British Commons votes trade-war powers to Cabinet.

Indicators—As second quarter closes steel production drops to below 25 per cent . . . Carloadings rise somewhat . . . So does electric power production . . . *Business Week's* index up a point to 67.3.

Washington Swelters as President and Congress Leave

WASHINGTON — Disregarding the destination toward which certain doubters believe we are heading, the President reaffirmed that the United States is "God's Country" and said he wants to keep it that way. After giving the late departed Congress a pat on the back for its "intelligence and good will" and disclaiming fascism, communism and regimentation, he embarked for Puerto Rico, the Virgin Islands, the Canal Zone and Hawaii to return for a cross-continental tour well ahead of the November elections.

But with both the President and Congress away there is still some hot weather mopping up to be done in administering the New Deal statutes. Perhaps the warmest work falls to NRA which, not finding Washington torrid enough went further South to uncover a hot spot. Executing his "sentence of economic death," to use his own designation, General Johnson lifted the blue eagle from the Harriman Hosiery Mills on April 20, refused to restore it on June 23, which resulted last week in throwing 653 out of work in a one-plant town. The employees, who had previously turned in all their Blue Eagles, replied by denouncing NRA and finally ejecting from town Fred Held, A. F. of L. organizer.

Ousting in Washington of John Donovan, president of NRA's own union, has done nothing to reduce the temperature, especially when the incident is to be a subject of Congressional investigation.

High Code Budgets

Other problems loom, not the least of which is the potential tax on industry and indirectly on the buying public entailed in code budgets. These range from $3,000,000 per industry down—the average of the 40 largest codes is $200,000 each. Even NRA knows that Congress will land on these expenditures with both feet.

Then there is the issue of assessing a company for each code under which its products fall. A ruling that this could not be done was hastily revised to allow multiple charges if deputies could show that the secondary code groups deserved it.

With service industries codes rescinded insofar as trade practice provisions are concerned, the cleaning and dyeing trade threatened to ignore labor provisions as well. It is, however, pretty well established that NIRA gives the President power to alter codes without voiding them entirely.

A tacit admission that NRA may have shoved price levels up too high may be seen in the executive order permitting bidders on government contracts to cut code prices for goods and services to the extent of fifteen per cent. The fact that such quotations then became the price to the public may result in deflating the whole price structure.

NRA's Industrial Advisory Board which met three weeks ago at Hot Springs, Va., convened again in Washington over the week end. While the first meeting gave endorsement to General Johnson's promise of blanket reforms, the industrialists are now getting more specific and insistent in their demands.

Progressive reorganization of NRA continues with the resignation of one of its oldest deputies, H. O. King, who left administration of Division IV to take executive charge of the copper industry's code. Although the move was in direct violation of an NRA regulation which forbids any man who has acted as deputy in the formation of a code, from representing the same industry before NRA, General Johnson, recognizing the need and unanimous request of copper leaders made an exception.

New Appointments

Mr. King's place is now filled by Robert L. Houston, former vice-president of International Business Machines, who has been serving as deputy in Division VII.

A new addition is James Cope who handled NRA for the Associated Press. His job is to humanize the legalistic (some say militaristic) orders and letters of NRA and lend them the clarity of an AP dispatch.

Other prevacation appointments of importance were made when the President announced membership in the stock exchange and the communications boards and the name of the new housing administrator. Joseph P. Kennedy, chairman, was appointed to the stock exchange board for five years, George C. Matthews for four years, James M. Landis for three, Robert E. Healy for two and Ferdinand Pecora for one year. Eugene O. Sykes was named as chairman of the communications board and James H. Moffett, oil executive, as the housing chief.

Industrial concerns in need of cash will be interested in the conditions laid down under which the RFC will advance funds. These are: adequate security; the applicant must be solvent; no credit available through usual channels; continued or increased employment of labor; must not exceed $500,000 and for not longer than five years; applicant must have been in business before January 1, 1934.

A program of payments must be set before the loan is made; interest is to be at the prevailing bank rate; funds may not be used to finance consumer sales, nor exports or imports; they may not be used for development or expansion into new fields; economic need for the product must be shown. Loans may be used to terminate receivership.

General Johnson has been entirely relieved of jurisdiction in labor disputes by the selection of an "impartial board," comprising Lloyd Garrison, dean of the Wisconsin Law School, Harry Alvin Mills, head of the Department of Economics, Chicago University, and S. Smith, Massachusetts labor compliance officer for NRA.

Throughout the summer, broad new plans for government mediation in labor disputes will be pounded out as a result of the joint resolution which was passed as a substitute for the controversial Wagner Bill. By his appointment of Miss Frances Perkins, as his representative in steel strike negotiations, the President puts the labor department in a stronger position than ever before. The three-man board of Justice Stacy, Admiral Wiley and Judge Mullenbach will report to him through Miss Perkins. While the resolution is broad in the powers granted to appoint "a board or boards," which may order elections for employees to select "representative of their choosing," the boards apparently cannot force employers to accept these groups. The outcome would seem to depend on a decision as to what "collective bargaining" really means.

Chief significance of the railroad labor adjustment act is that it introduces the principle of compulsory arbitration. The board of adjustment created by the new law will deal only with disputes arising over interpretation of agreements dealing with wages and working conditions, but its findings will be final and binding on each party.

While the housing act recently signed by the President makes direct provision only for the reduction of the financial costs of building, the administrator of the act is expected to exert influence to decrease the material and labor costs as well. The large demand for low cost housing is hopefully regarded as a potential stimulus to the capital goods industries.

Price Cuts Delay Detroit's Summer Slackening

DETROIT—It is likely that June figures of automobile production will run considerably above expectations at the beginning of the month. The price slashes introduced on cars selling below $1,000 have had the desired stimulating effect, postponing the traditional summer slump for the time being. Chevrolet production ran slightly above the May total, and the price reduction introduced by Ford on June 14 to maintain competitive position may result in Ford sales also above the May figure. Schedules are generally being maintained by a fairly even trend.

Final results of General Motors show week, indicate an increase of 42 per cent over 1932 in the sale of cars and trucks, truck sales being up 177 per cent. Plymouth, on June 21, assembled the largest number of cars in any single day in the history of the company, 2113 rolling off the end of the assembly line. So popular is Buick's new model that it has been impossible to build up dealer stocks. Studebaker is rapidly increasing its schedule of new car production. But despite these straws there is little evidence that total auto output will equal May figures. With the exception of 1933, peak production has not occurred in June since 1922.

July output prospects are reported as good, being estimated 20 per cent better than two weeks ago and showing only a slight reduction below June. If this is correct, the showing will be better than last year and more in accord with the past twenty years.

Discussion on holding the January shows continues with independent manufacturers and dealers by no means satisfied that they should be abandoned. The stimulation to sales which these shows cause must be balanced against the tool rush, excess cost and likelihood of labor troubles. It looks at present as though at least the 1935 shows will be passed in an effort to regularize production by staggered introduction of models. Many existing models may carry over into next spring. It is unlikely, however, that the makers themselves have their plans definitely settled; competition has never been keener, particularly in the low priced field, and should a new Ford appear, Chevrolet and Plymouth especially would be forced to follow.

Development work is going on in diesel engines comparable to that spent on aircraft a few years ago. One manufacturer states that within a year diesels will replace gas engines in trucks and buses. Reduction in size and weight brings the diesel to a basis comparable with the gas engine in weight per horsepower; variable speed and accurate metering of oil to the cylinders makes it as flexible.

Quiescent, rather than permanently solved is the labor situation. This is evidenced by the experience of one parts company; in May the situation was such that a strike deadline was set but a period of layoff coming just at that point removed the threat. In resolutions adopted in the two-day session of the automobile workers union concluded Sunday, the company union was severely condemned, claims being made that workers are coerced by managements into joining. In the union fight for membership, the company union would be anathema; the lukewarm attitude toward the Labor Board lies in its limitation on freedom of action through the recognition of proportional representation.

***A Century of Forging*—The 100th anniversary of the invention of the steam hammer is commemorated in Chrysler's exhibit at the Chicago fair. A 4,000-lb. Erie hammer turns out alloy steel drop forgings for Plymouth steering knuckles**

Discrimination Cases

The Labor Board is busy clearing up cases of claimed discrimination in recent St. Louis and southern disturbances, as well as those growing out of recent layoffs in Detroit. In one case, out of roughly a 13,000 reduction in force only thirteen cases of discrimination were claimed by the union; in another, three out of 1300. It is thus evident that the layoff policy of the board is not meeting with the magnitude of difficulties anticipated; both sides are playing according to the rules of the game.

In the meantime numerous reports favorable to the operation of company unions are available. Picnics, bands, athletic teams, safety and welfare activities are being organized by employ-

ees through their organization. A point frequently stressed is the opportunity offered both sides to become acquainted with the viewpoint and problems of the other. In the paint and trim shop of one company, management offered to substitute a day rate for the bonus system, but this was voted down; an offer to reduce the size of the gangs in the bonus groups was likewise vetoed by vote of the workers. A persistent topic in co-union discussions is the desire on the part of the workers for a regularized industry, offering steadier work than at present. This parallels thinking going on by management as to ways and means, of which staggering models is only one indication.

Equipment and tooling programs are as yet not in evidence; while some buying was done during the peak in March and April to plug weak spots in the lines and by parts suppliers to meet schedules not much business will be in evidence before late summer. With price reductions on cars increased, pressure is placed on parts manufacturers to reduce their prices accordingly. New model cars, when introduced, will continue the streamline tendency evident in recent models.

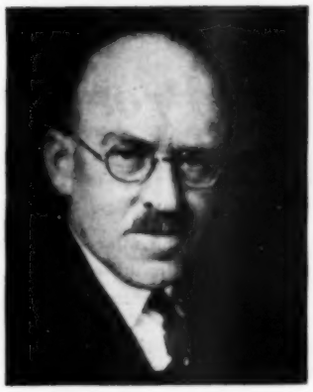
A favorable aspect of the industry and for all industry is great increase in the domestic sale of trucks and of foreign sales of passenger cars. General Motors sales abroad in May, 1934, were the highest in any month since July 1929.

Col. Phipps Appointed to Three Code Authorities

Colonel Frank A. Phipps, a graduate of West Point and the Yale Scientific School, has been made administration member for the code authorities of the steel tire manufacturing, locomotive appliance and railroad special track equipment industries. Colonel Phipps served with the army from 1905 to 1926, when he resigned to manage the office of a Stock Exchange house.

Charles P. Wood, of Lockwood Green Engineers, Inc., has been appointed government member of the code authority for the railway car building industry. Mr. Wood, a Cornell, graduate, was formerly with Ridgeway Dynamo & Engine Co., the Standard Gas Power Corporation, the Empire Floor and Wall Tile Co., Lewis A. Riely, consulting engineers, and served as trade commissioner in France and Belgium.

R. H. Danforth, professor of mechanics and materials at the Case School of Applied Science, has been named as administration member of the drop forging code authority.



R. E. Flanders Nominated for A.S.M.E. Presidency

At the semi-annual meeting of the American Society of Mechanical Engineers held at Denver, Colo., on June 25, Ralph E. Flanders, president, Jones & Lamson Machine Co., was selected by the nominating committee to head the slate of officers for the coming year.

Other nominees designated by the committee were as follows: vice-presidents: E. W. O'Brien, editor, *Southern Power Journal;* James H. Herron, president James H. Herron Co.; H. R. Westcott, president, Westcott & Mapes, Inc.; managers: B. M. Brigman, dean, Speed Scientific School, University of Louisville; Alfred Iddles, vice-president, United Engineers and Constructors, Inc.; J. W. Haney, professor, University of Wisconsin.

More Funds Needed for Treaty Navy

From the annual appropriation for the Navy Department $88,000,000 is allotted for the construction of one 10,000-ton cruiser with 8-in. guns and for three 10,000-ton cruisers with 6-in. guns.

The President has earmarked $40,000,000 of PWA funds for construction of two 1,850-ton destroyers, twelve 1,500-ton destroyers, and six submarines of about 1,300 tons. These ships will not be completed for about two to three years. So far no money has been appropriated to make possible the terms of the Vinson treaty-navy act.

• INDUSTRIAL REVIEW •

• In line with expectations the trade in machinery and machine tools has quieted down materially. Supply business is holding up remarkably well and there are a few orders and some inquiry for special and semi-special machines, but orders for standard tools are almost nil. Labor conditions in the industry are giving no cause for alarm just now.

• In the East there is more talk of loss of confidence in the President and his policies, and present lack of business is attributed largely to this factor. Inquiries for standard machine tools in Pittsburgh have been practically nonexistent during the past fortnight but there is enough interest in special tools to keep the distributors busy figuring. The steel industry is not expected to buy much equipment until later in the third quarter.

• Cleveland reports a June trade 50 per cent below May, and expects little improvement in July and August. Failure of automobile manufacturers to go ahead on new, model plans has been a disappointment, but there has been some activity on repair work in equipment building shops. Many Detroit shops are down for vacation and inventory until July 15. From then on the opinion is that a general increase in activity will develop. The current absence of disturbance in labor circles is looked on as the calm before the storm, but there is hope that means will be found to prevent serious trouble in the fall.

• Several Cincinnati machine tool plants are considering closing down for vacation because of lack of business. June was a poor month for orders and July and August are expected to be as poor. Things are rather dull in Chicago, too. Much business is pending but releases are being held up. What business there is is spotty. Small tool business in St. Louis has held up well but new machinery orders are missing and inquiries few. In Milwaukee inquiries have died out and orders are scarce. Much depends on whether the automobile manufacturers go ahead with new models.

Export Market Holds Promise for Implement Makers

WASHINGTON—From a peak of $141,000,000 in 1929, the export trade in agricultural implements fell to $10,500,000 in 1932. This picture has reduced a few exporters to resignation as to the future of the export trade, but recent figures indicate that a revival is at hand, according to a report from the Bureau of Foreign and Domestic Commerce.

Export business is a prime necessity in a revival of the domestic farm equipment business. Since 1920, the first year for which production figures are available, the share of implement production entering export trade has shown a steady increase. The table given below shows the value of production from 1920 to 1931, the value of exports from 1919 to 1933, and the percentage of the latter to the former from 1920 to 1931. (The export column contains "related products," such as farm engines, wagons and drays, etc., not included in agricultural implement export classification but are grouped with agricultural implements in the table to make the figures comparable with the value of implement production.) No production figures are available since 1931, but on the past record, it is safe to assume that the share entering the export trade has not declined seriously.

Production and Exports of Farm Implements

Year	Production Value	Export Value	Percentage of Production for Export
1919	.....	$41,195,494	..
1920	$536,945,000	51,286,000	9½
1921	328,041,000	40,979,000	12
1922	209,640,000	27,424,000	13
1923	364,854,000	55,635,000	15
1924	323,367,000	65,148,000	20
1925	391,812,000	83,880,000	21
1926	461,400,000	91,659,000	20
1927	460,881,000	96,691,000	21
1928	524,255,000	123,160,000	23
1929	606,622,000	147,090,000	24
1930	507,002,000	119,826,000	24
1931	214,391,000	56,891,000	27
1932	.....	10,993,351	..
1933	.....	12,814,388	..
1934 (Jan.-Apr.)	.....	6,100,000(1)	..

(1) Preliminary.

The continuing increases during the 11-year period parallel the American development of power farm equipment and reflect the desire of foreign agricultural markets to adopt labor-saving farm machinery. The most important markets during the period were those, the agricultural practices of which are similar to our own and include Canada, Argentina, Russia, Australia, North Africa and other countries where large farm holdings predominate.

There are three things which have placed the United States in the lead as a supplier of power farm equipment, namely, the system of mass production; the enormous domestic demand in the great laboratory of the Middle West, and the ingenuity which has designed the machines to lower production costs in our farm areas. All these factors are of the greatest necessity in the development of a farm equipment industry, and the United States is perhaps the only country where all these factors are present. Therefore, it is reasonable to assume that the United States will continue to supply the bulk of the world's power farm equipment.

To illustrate, Europe also has an industrial system, but the domestic demand in Europe is for equipment to cultivate small individual holdings and therefore there is no incentive for European farm equipment industry to concentrate on equipment for the large farms of Canada, Argentina and similar markets. Because of the small farms, the agricultural research which is admittedly as profound as that of the United States is directed to improving the yields of small holdings, and is therefore not likely to recommend to European manufacturers the production of equipment to compete with American power farm equipment.

Although it would seem that American manufacturers will continue to obtain the bulk of the world's power farm equipment business, they cannot afford to sit idly by and await the arrival of business. There is always present the threat of underselling by countries where labor is cheaper. The backed up demand for farm equipment has reached enormous proportions in the past few years and it can lead to the production of equipment by our competitors for the sole purpose of meeting this demand without regard to the domestic needs of those competitors. This is especially true in Canada where a revival of farm purchases will create an immediate demand for enough equipment to make it advantageous for Canadian or European manufacturers to produce equipment solely for the Canadian market. This situation holds true in other markets, and even now is being manifested in the case of France and the French possessions in North Africa. During the first four months of this year, France and French Africa are the only important implements markets which have failed to record gains in purchases of American farm equipment.

The American exporter has the jump on his competitors in being established in the most attractive markets and having the right equipment to offer. Moreover, the development of equipment in the past four years to meet the needs of the American small farm gives him a wider field of endeavor, especially in Europe where small holdings are the general rule. The new reciprocal tariff bargaining, the Export-Import banks, the drop in the value of the dollar, and other Administration measures will relieve many of the artificial obstacles which have seriously hampered the free movement of implements in the past few years.

French Foreign Machine Trade Falls

A substantial decrease, during the first quarter of the current year, as compared with the corresponding period of 1933, was registered in France's foreign trade in machinery and metal manufacturers, according to a Commerce Department report. Imports during the 1934 period were valued at 189,973,000 francs against 227,934,000 francs for the first quarter of last year, a drop of 16½ per cent. Exports during the first three months, valued at 264,723,000 francs compared to 360,499,000 francs for 1933, showed a loss of 26½ per cent.

An increased volume of machinery imports into France at greatly reduced prices is causing considerable concern to French industrialists, who are demanding increased protection. Included among the specialties where this is evident are electric dynamos and transformers, telephone and telegraph apparatus, automatic signaling apparatus and electric wire and cable stock. Other imports, which registered notable increases in the first three months of 1934, were routing machinery and cylinder compressors, from 226 tons to 363 tons and weighing machinery and scales, valued at 1,515,000 francs against 727,000 francs in 1933.

Leipzig Fair to Be Held in August

To be held from August 26 to 30, the Leipzig State Fair this year will include some 7,000 exhibits from 22 countries, including the United States. Detailed information may be obtained from the Leipzig State Fair, Inc., 10 East 40th St., New York, N. Y.

Foundry Equipment Orders Fall in May

May orders, as reported by the Foundry Equipment Manufacturers Association, had an index of 66.5 as compared to 67.9 for April and 25.6 for May, 1933. Shipments were considerably improved at 75.6 as against 55.5 for the preceding month and 24.5 a year ago. Unfilled orders declined from 63.0 in April to 52.1 in May, but were far above the figure of 16.8 registered in May, 1933. The three months' average of gross orders was slightly better at 69.9, compared with 67.7 for April and 18.3 for last year.

Baldwin Wins Chilean Locomotive Order

In the face of keen competition, particularly from Germany, the Baldwin Locomotive Co. succeeded in obtaining an order from the State Railways of Chile for ten locomotives. These are to be of the "Mikado" type and will be placed in service on the meter gage northern Longitudinal Line. The amount involved in the transaction was approximately $400,000. It is probable that all of the locomotives will be shipped at one time to reach Chile about the end of the current year.

S.A.E. at Saranac

Although there were no production sessions at the Saranac meeting of the Society of Automotive Engineers, June 17-22, the attendance was gratifying and much interest was shown in the other sessions. Body building, stream-lining, prevention of noise, safety truck operation, diesel engines, fuels, engines, lubricants and bearings were all discussed, some at considerable length. Railcar design and performance as well as the economics behind them had a thorough airing coupled with the somewhat puzzling problem as to whether railcars have a place in the S.A.E. or should be shifted to a body dealing with railway transportation.

Aviation also had its sessions with the propeller problem a prominent topic, and the airplane engine receiving considerable attention. The subject of bearings brought out the fact that the increasing demands being made of automobile engines were yearly bringing them closer to engines in the aviation class. Higher sustained speeds, due to more powerful engines and better roads, make greater problems for the engine builder.

Babbitt bearings are said to be failing under these new conditions, which are forcing the use of copper-lead alloys, following aviation practice. Research by Studebaker and others is being made to find an alloy which will be "kind" to the crankshaft (as tobacco ads put it), and will not be too expensive either as to material or machining. Lubrication, too, requires greater attention at continued high speeds. This applies to both the kind of oil and to its application to the bearing.

Several experimental cars were demonstrated on the none too smooth roads around Saranac. Water sports, golf, tennis and other games provided entertainment.

Metal-Working Code Hearings Scheduled

Date	Place	Deputy Administrator	Association
July 6	Commerce Bldg.	J. G. Cowling	Gray Iron Founders Society (cost principles)
July 10	Willard Hotel	N. W. Foster	Independent Oil Burning Equipment
July 11	Commerce Bldg.	J. G. Cowling	Vacuum Cleaner Manufacturers (cost principles)
July 12	Willard Hotel	J. Dilworth	Floor Machine Manufacturers

Exports of Machinery During May, 1934

	May 1934	April 1934	May 1933
Electrical machinery and apparatus	$5,263,026	$5,616,661	$3,109,410
Power generating machinery (except automotive and electric)	461,843	487,761	210,715
Construction and conveying machinery	486,232	527,329	187,363
Mining, well and pumping machinery	1,431,632	1,582,840	890,028
Power-driven, metal-working machinery	1,596,546	2,463,052	430,556
Other metal-working machinery	168,193	483,903	83,574
Textile machinery	591,322	561,402	247,612

Exports of Metal-Working Machinery During May, 1934

	May 1934	April 1934	May 1933
Engine lathes	$43,777	$146,618	$7,679
Turret lathes	54,949	54,286	11,255
Other lathes	29,109	54,367	6,763
Vertical boring mills and chucking machines	34,906	7,121	8,848
Thread-cutting and automatic screw machines	109,743	124,249	19,524
Knee and column type milling machines	62,411	100,044	2,563
Other milling machines	187,109	180,888	14,685
Gear cutting machines	115,210	177,400	31,962
Vertical drilling machines	18,177	219,545	9,659
Radial drilling machines	21,076	25,637	.....
Other drilling machines	82,478	330,518	7,570
Planers and shapers	32,899	4,977	2,753
Surface grinding machines	28,788	20,668	3,432
External cylindrical grinding machines	58,717	60,206	34,463
Internal grinding machines	71,358	132,428	9,225
Tool grinding, cutter-grinding, and universal grinding machines	54,473	73,251	18,073
Other metal-grinding machines	75,595	64,772	8,894
Sheet and plate metal-working machines	87,345	296,963	53,087
Forging machinery	75,799	75,083	12,741
Rolling mill machinery	108,379	78,329	51,514
Foundry and molding equipment	46,901	20,692	18,558
Other power-driven metal-working machinery and parts	197,347	215,010	97,308

Other Metal-Working Machinery

Pneumatic portable tools	56,610	86,965	14,861
Other portable and hand or foot operated metal-working machines and parts	46,425	59,649	17,514
Chucks for machine tools	11,003	7,404	2,871
Machine operated pipe and thread cutters, stocks, dies, taps and other machine operated tools	36,842	315,989	26,039
Other metal-working machine tools	17,313	13,896	22,289

Stedfast for 50 Years

Fifty years ago, on July 7, 1884, A. R. Stedfast, then a boy of fourteen, went to work for Hill, Clark & Co. on Oliver Street, Boston. This meant a four-mile walk plus a ferry ride twice a day, and the salary was $3 a week. Sweeping out the office and store, helping to ship machines, assisting in keeping stock were part of the early work of the man whose name now forms the front end of the firm of Stedfast & Roulston, who succeeded Hill, Clark & Co. and who are still on Oliver Street a few steps from the original location.

Three Generations Serve Whiting

Machine builders whose names were famous when Albert Stedfast began his acquaintance in this line are now forgotten and others have become prominent. Men in New England who have built new businesses or enlarged old ones have known him all through the years. And there is no more welcome visitor in any of these plants today than Albert Stedfast, who still travels with his men.

Whiting Corporation Reaches Fiftieth Year

With John Hill Whiting, its founder, still active as chairman of the board, the Whiting Corporation is this year celebrating its golden anniversary. After patenting his early inventions, embodying improvement in cupola construction and a car wheel cleaning machine, Mr. Whiting launched his own business in 1884.

The company through its progressive development of new equipment achieved prominence at the Chicago World's Fair of 1893. The following year a small portion of the present plant was built at Harvey, Ill. Later traveling cranes and special shop equipment were added to the line.

Other companies were taken over as subsidiaries, including the Swenson Evaporator Company, the Grindle Fuel Equipment Co., a pioneer in pulverized fuel, and the Joseph Harrington Co.

Associated with Mr. Whiting for the past 30 years, and now president and general manager of the corporation, is General T. S. Hammond. The third generation is represented by Steven H. Hammond, assistant to the president.

• PATENTS •

June 19, 1934

Metal-Working Machinery

Friction Clutch. Robert T. Haselton, Cincinnati, Ohio, and Bernard H. Mersch, Covington, Ky., assigned to the Cincinnati Shaper Co. Patent 1,963,364.

Gear Cutting Apparatus. Charles C. Merz, Indianapolis, Ind. Patent 1,963,756.

Lapping Machine. John George Holtzapffel Budd, St. Pancras, England. Patent 1,963,884.

Swaging Machine. Michael H. Flynn, Hartford, Conn., assigned to the Allen Manufacturing Co. Patent 1,963,942.

Tools and Attachments

Reamer Pilot. Clarence F. Petzinger, Cleveland, Ohio, assigned to the Cleveland Twist Drill Co. Patent 1,963,803.

June 26, 1934

Metal-Working Machinery

Method of grinding Straight and Helical Teeth on Spur Wheels. Paul Uhlich, Weissensee, near Berlin, Germany, assigned to Deutsche Niles Werke Aktiengesellschaft, Weissensee, near Berlin, Germany Patent 1,964,233.

Chip Remover for Metal Working Machines. Arthur J. Lewis, Stratford, Conn., assigned to the Baird Machine Co. Patent 1,964,361.

Grinding Machine. Waldo J. Guild and Harold L. Blood, Worcester, Mass., assigned to the Heald Machine Co. Patent 1,964,433.

Assembling Machine. John Q. Holmes and William H. Roberts, Anderson, Ind., assigned to General Motors Corp. Patent 1,964,434.

Tools and Attachments

Milling and Like Cutting Tool. Ralph-Miller, Birmingham, England, assigned to Ernest Penn, London, England. Patent 1,964,130.

• EXPORT • OPPORTUNITIES

Hans Heimpel, Calle Independencia 80 E., Mexico, D. F., wishes to get in touch with manufacturers of coil-winding machines and tools for use in manufacture of armature coils for a.c. and d.c. motors and generators.

*7516. Rio de Janeiro, Brazil. Dairy machinery and equipment.

*7522. Tel Aviv, Palestine. Chocolate, cocoa and confectionery manufacturing machinery.

*7527. Port of Prince, Haiti. Machinery for manufacturing carbonic acid gas from wood, and wall-board manufacturing machinery.

*Interested American firms and individuals may obtain the names and addresses of the foreign firms making these inquiries upon application to the Bureau of Foreign and Domestic Commerce, U. S. Dept. of Commerce, Washington, or any district or cooperative office.

• PERSONALS •

H. H. TIMKEN resigned June 16 as president of the Timken Roller Bearing Co., Canton, Ohio, but remains the chairman of the board. He is succeeded as president by WM. E. UMSTATTD who has been with the company since 1919. Mr. Umstattd has worked in all departments of the plant. Lately, he was advanced to the position of executive vice-president. HENRY H. TIMKEN, JR., was elected a vice-president of the company, and also a vice-president of the Timken Steel & Tube Company.

DONALD G. CLARK, of the Brown & Sharpe Mfg. Co., was elected president of the National Association of Purchasing Agents.

ALBERT A. JONES has been elected a vice-president of the International Harvester Co., in charge of manufacturing.

H. D. RUNCIMAN has become associated with the Precision Grinding Wheel Co., Inc., Philadelphia, Pa. His headquarters will be at the Detroit office, 2832 East Grand Blvd.

• OBITUARIES •

JOHN D. CRAFT, 67, one of the founders of the Hercules Corp., Evansville, Ind., died after a long illness. He was formerly vice-president and general manager. At one time Mr. Craft was associated with the Graham Brothers, having designed the first Graham truck.

JAMES C. GRIFFIN, 69, founder and president of the Griffin Mfg. Co., manufacturer of hardware supplies, Erie, Pa., died June 20. He founded the company in 1902.

MICHAEL A. HERALD, president of the United Car & Equipment Co., Pittsburgh, died at the age of 51.

MORTIMER B. SKINNER, 69, founder and former chairman of the board of the M. B. Skinner Co., manufacturers of tools and mill supplies, South Bend, Ind., died recently. At one time Mr. Skinner was president of the American Supply & Machinery Manufacturers' Association.

• MEETINGS •

SILVER BAY CONFERENCE. Seventeenth annual conference on industrial relations, August 22-25. Silver Bay on Lake George, N. Y. E. C. WORMAN, executive secretary, 347 Madison Ave., New York, N. Y.

American Machinist

REFERENCE BOOK SHEET ©

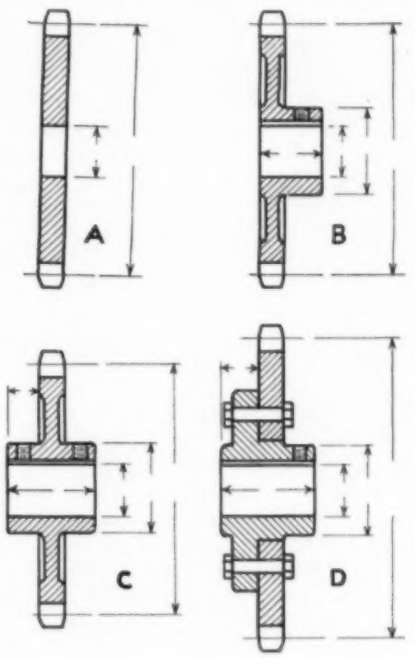
Inquiry Forms for Sprockets

At the annual meeting, May 3-4, 1934, the American Gear Manufacturers Association adopted the accompanying codes of recommended practice for use by purchasers of sprockets. All dimensions that are required by the gear manufacturer are shown, together with many if not all needed by the purchaser. Only important dimensions should be marked with the allowable limit of error, and other dimensions should be marked approximate only.

Roller Chain Sprockets

Indicate all necessary specifications. Hub lengths and hub diameters not otherwise specified will be to A. G. M. A. standard proportions. If bushings, heat-treatment or unusually close limits are required, these should be specified.

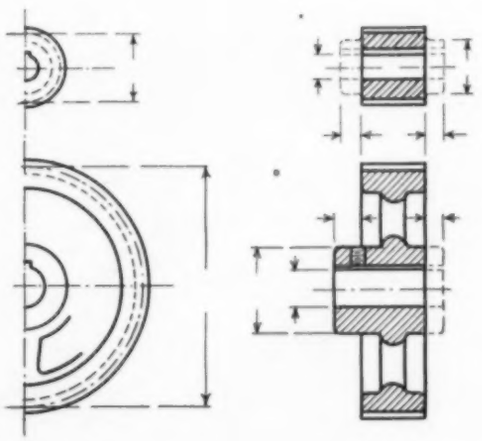
Specifications	Driver	Driven
Quantity		
Material		
Heat-treatment (if any)		
Number of teeth		
Pitch diameter		
Bore		
Keyway size, if desired		
Setscrew size, if desired		
Hub diameter		
Location of setscrew with keyway		
Type of sprocket—A, B, C, D, or spoked		
If type A, counterbore and bolt hole specifications		
If Type B, or C, give hub projections		
Solid or split		
R.P.M		
Horsepower to be transmitted		
Center distance		
Chain pitch, width, and roller diameter		
Single, double, triple, etc., type		
Type of drive, constant or intermittent		
Nature of load, steady or impulsive		



Sprockets for Inverted-Tooth Chains

Indicate all necessary specifications. Hub lengths, hub diameters, and the amount of taper on taper keyseats, when not otherwise specified, will be according to A. G. M. A. standards. When taper keys are to be used the direction from which the key is to be driven should be stated. If bushings, heat-treatment or unusually close limits are required they should be specified.

Specifications	Driver	Driven
Quantity		
Material		
Heat-treatment (if any)		
Number of teeth		
Pitch diameter		
Bore		
Keyway dimensions, if desired		
Setscrew size, if desired		
Hub diameter		
Location of setscrew with keyway		
Solid or split		
R.P.M		
Horsepower to be transmitted		
Pitch and width of chain		
Make of chain		
Center distance		
Type of drive, constant or intermittent		
Nature of load, steady or impulsive		



Rivet Hole Reaming

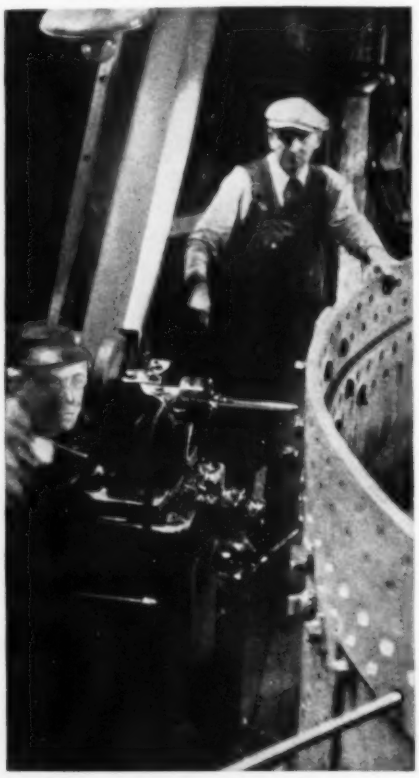
FRANCIS A. WESTBROOK

One of the reasons why the business of the Portland Company is improving is that this concern, although an old one, has showed a great deal of ingenuity with regard to its equipment and the means it has provided to reduce manufacturing costs. A good example is the way in which rivet holes on large steel paper mill digesters are drilled and reamed.

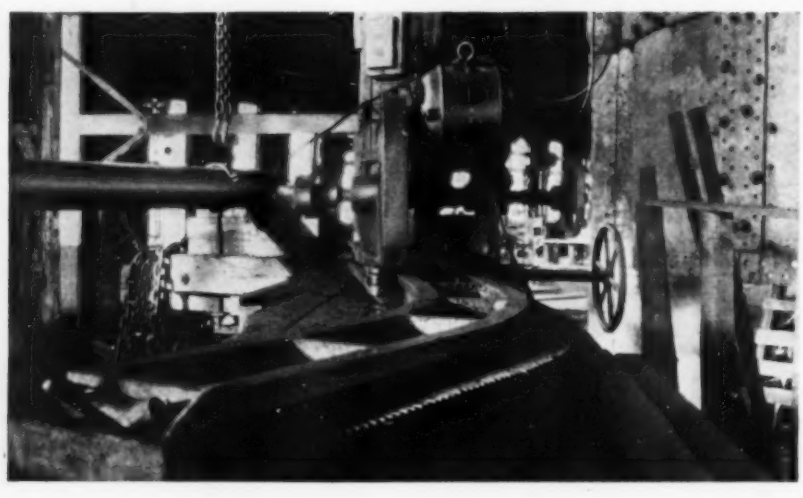
These digesters have cylindrical bodies with conical or spherical ends and are made of steel boiler plate often as thick as 1¼ in. The sections are provided with butt straps and rings for the riveted joints. Because of the weight of the work, it is none too easy to match the holes in the butt straps with those in the plates.

An efficient means of handling the cylindrical sections is to punch the holes as accurately as possible and then, by temporarily bolting a few holes, to set up the work on a bull-nose riveter. A 5-ton electric hoist having three speeds was roped 8 to 1 so it could handle 40 tons. One of the speeds is used for inching for close adjustments. On top of the riveter is placed the reamer, conveniently driven. The work is raised or lowered to the reamer by means of the inching control and is guided horizontally by the operator who uses a bar in one of the punched holes. During this operation, the work is freely suspended so it may be easily moved. A small jet of water is directed on the hole during the reaming process.

The advantages are obvious — the holes in the butt strap may be accurately matched with those in the cylinder, the metal stressed by punching is removed and the work is handled conveniently. When the reaming has been completed, riveting is done in the same set-up using a pressure of 1,500 lb. per sq.in. on the hydraulic ram.



Rivet holes in a large digester are reamed by suspending the work in a crane and swinging it by a crowbar



A curved track has been provided to guide the reaming equipment for use on conical heads

Handling the conical heads is more complicated because the surface of the cone is at an angle with the base and would have to be tipped if the reamer were to be kept at right angles to a horizontal plane. This is overcome by placing the cone on an elevated spider by means of a traveling crane. A special drilling machine has been made up to travel on a track having a curvature approximately the same as that of the average digester head. The drill, which is actually used as a reamer, is driven by a 5-hp. motor set on the same base and connected to an electrical outlet by means of a flexible conduit. By turning a handwheel the whole machine, reamer and motor, may be made to travel around the curved track. While the track is not a complete circle, it is not a difficult matter to shift it to accommodate any cone seam.

When necessary to drill holes in the double curved plates forming the conical heads and the beginning of the cylindrical section, two radial drills are used. Both drills have merely been set on the shop floor so they may be moved from place to place when necessary by means of the traveling crane. The crane is also used to place the work in the drills at the proper angles.

Increasing Overhead for Profit

JOHN E. HYLER

Strange though the above title may seem, there are many times when it is outstandingly true. In fact, there can hardly be an improvement made in the shop, new tools designed and put into use, a new machine or piece of equipment bought without adding to the overhead. We seldom need to be reminded of that fact. What we are likely to lose sight of is the balancing or overbalancing factor that is often set up at the same time and by the same action.

An investment is made in an experimental department, let us say. The plant setting up this experimental department has never had one before, and as a result, has been making quite a few costly mistakes. Setting up that department is going to add to the overhead—there can be no question of that. But neither can there be any question that the department is going to save far more than enough to pay for maintaining it. Here, then, is another case of increasing overhead for profit. From now on, to use the expression of a chemist, this firm is going to "make its mistakes in a test tube."

THE ROUND TABLE

The Little Fellow's Chance

Ed had been staring at his old friend for so long that Al finally broke the silence that had fallen between them. "What's the matter with me? Did I forget to brush my hair, or haven't I got a necktie on?"

"Oh, you're dressed all right. I never saw you when you weren't, and how you manage to keep looking so darn respectable after working around a machine shop I never could see. No, it isn't that, but I was wondering what made you look like a cross between the cat that swallowed the canary and Desperate Desmond determined to carry through some bold plan that leads to life or death."

Al laughed, "You're getting awful metaphorical in your language, if you know what that means. But I guess I know what makes me look that way."

"Well, what is it?" asked Ed impatiently as Al hesitated.

"Do you remember that argument of ours, a month or so ago, when we tried to figure out what chance a small shop has under NRA? I said the big fellow got all the breaks and you said he didn't?"

"Yes, and I think you were right. Look at all the dirt the Darrow Committee dug up. Why, I never heard of so much oppression! The little fellow is just out of luck under NRA."

"That's just where you're 'way off," returned Al with vigor.

"What's this?" asked Ed in surprise. "Have you changed around to the other side of the argument, really? Or are you just doing it to get up another argument?"

"Not that, Ed. I really see a big opportunity for the fellow with a small shop, like me."

"Where, Al?"

"Just here. Has Williams bought any new equipment lately? No, the directors won't let him. Does he need any?"

"I'll answer that one," interrupted Ed. "How the devil he expects me to get out decent work on some of the junk in my department I can't see. But complaining don't do any good. I've gone as far as I dare."

"All right. Now, what are you doing about new designs? Darned little, if I'm any good as a guesser. The company is just sitting back waiting to see what happens in Washington. The directors have lost so much that they're afraid to take a chance. They won't approve new designs because they might involve buying some new machine tools."

"Yes, and I think they're right too. We've got a lot invested in plant and machinery, and we can't afford to take a chance on anything new until we know what the Brain Trusters are going to load onto us next. You're not going to take any long chances yourself, are you? With things the way they are?"

"Ed, that's just what I am going to do," said Al. "The big fellows in my business are taking just the same attitude as your board of directors. Their costs are going up as their machinery wears out, and their product is out of date. They've lost their nerve and their push, and that's just the opportunity I want. That's the reason for the cat-ate-canary expression."

"Yeah, maybe you better not be so sure of that golden opportunity. The big fellows may not be so dumb to lay low for a while. How about the rest of it?"

"What you call the Desperate- Desmond?" laughed Al. "Oh, that just means I'm going after the markets and get in before the elephants wake up."

"All right, all right," grumbled Ed, entirely unconvinced. "But don't blame me if the elephants step on you and you have to be scraped up with a shovel."

Is it wise to be extremely conservative under present conditions, as Ed maintains?

Or should the manager of the small, alert shop jump in now and take chances?

Discussion

Subsidized Suggestions

Suggestion systems in general seem to start off with a burst of enthusiasm that soon dies down. Frequently, men will offer worthwhile suggestions, but unless their interest is maintained they will unconsciously assume that they have already turned in all of their new ideas and then let the matter rest. The difficult matter is to keep them interested.

To be successful, a suggestion system must afford an ample cash award for all suggestions that are to be put into use. Suggestions reflecting careful thought but which are not practicable from all standpoints should receive honorable mention. Probably the quickest way to kill interest in suggestions is for the foreman to let it be known that he thinks they are a waste of time.

Workmen are often reluctant to offer

suggestions for fear of antagonizing the foreman. Foremen can give the system a boost if they will take an active and permanent interest in it. Management can stimulate their interest by impressing upon them that the value of the suggestions offered by men in their departments reflects directly upon their respective abilities as supervisors. The number of really worthwhile suggestions that a foreman will receive from his men if he is in full sympathy with the program is surprising.

WALTER E. BENEDICT,
Plant Engineer,
Sloane-Blabon Corporation.

False Security

A large percentage of us live in mortal fear of starvation, hence our need for some assurance that our means of livelihood will not be removed. It is because of our intricate economy that man is dependent upon the good will of his fellow man. This fellow man is usually the same person for a large number of people—their employer. It is upon the character of this employer that so much depends. His employees need to feel that their jobs are secure, providing they do satisfactory work. Without this security, the employees are not in position to do their work well. They are working with their hands in one place while their minds are elsewhere.

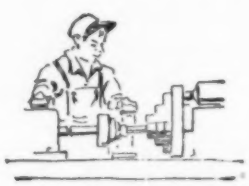
The relation between employer and employee has changed with the advent of large corporations, and the employer of five-thousand hands has little chance to know all his men; their relation is impersonal. Any employer who leads his employees to believe that their jobs are secure as far as he is concerned, while in reality they are not, is betraying a trust. The employer himself has his limitations. Any plan by which he can encourage his men to provide for the future shows an added interest for their welfare. —E. A. FREY.

Al's ideas are sound but his plans are not. In spite of the fine things he hopes to accomplish, there is little he can do about the matter. Still, there is too much value in his ideas for them to be totally ignored. Some feasible plan should be found. It would have to be one in which the employees are the leaders, for it is their money about which the problem centers.

Perhaps a company banking system might work, with the employees as officers. Or a company account at the bank, wherein so much is deposited by each worker out of every pay envelope. To add zest to the plan, the management might arrange it in the form of a competition, the ones saving the most at the end of the year being awarded a bonus. These are merely suggestions. The problem is one that, if correctly handled, will heighten the mutual feelings of regard all around, and the general effect on industry and prosperity will be for the better. —WILL HERMAN,
Superintendent, Tanenbaum & Son Oil Company.

To give an employee the impression that his job is going to last indefinitely will give him a false security that prevents saving and encourages unwise spending. On the other hand, to keep employees in constant fear of losing their jobs, means that purse strings everywhere will be tightened, to the detriment of all. The employee should have a fairly good idea as to how long his present job will probably last, and he should be encouraged to make his plans accordingly.

Most employers are well enough



posted to know approximately how long they can keep up the present rate of production. Local and national calamities may disrupt calculations, but such disruptions would do greater harm if the employees had felt that their jobs were permanent.

If men are constantly in fear of losing their jobs, they and their families, aside from the mental strain involved, cannot get many of the things they could afford if they were sure of a steady income. —MORRY TANENBAUM.

Works Councils and Unions

Of many types of employees, there are but a few who can serve to advantage on a works council. There is the ignorant fellow with a loud voice who is sure to "steal and show" and waste the allotted period on inconsequentials. There is the suspicious type who enters the room with the air of a tomcat peering into a strange garret. Then there is the chap who, though loud-mouthed in the presence of his fellows alone, fairly withers in the presence of management. All that can be gotten out of him are weak and vacillating opinions.

One thing that must be provided for in establishing a works council is that the elections at which the men choose their representatives must be frequent. Otherwise, some suspicious workman may start the report that the reason the works council is functioning so smoothly is that so-and-so is falling into line with every suggestion of the management. There must be the opportunity to point out that the men have frequent chances to remove so-and-so by a majority vote. —JOHN E. HYLER.

Within Reason

It is well known that 99 per cent of all mechanics lack the ability of directing their own activities. Unfortunately, this same 99 per cent dislike having their activities directed. Because the average man does not like to be bossed and resents verbal instructions every half-hour, certain regulations have long since been formulated to govern routine shop-practices. It has long been the golden rule among mechanics to tidy-up machines or benches after using them.

Where a shop is run in a haphazard way with no thought of housekeeping; where lines of authority are not sharply defined; and where working conditions are not conducive to orderliness; when the clean-up period arrives, both the foreman's and the men's nerves are on edge and misunderstandings are likely to occur. How will disciplining a man for not cleaning up after a slovenly fellow worker improve the departmental deportment? If the foreman displays temperament and asks a workman what he is getting paid for, and the workman replies, "I don't know. What do you think?" then that foreman had better begin to think. —IRA S. WILLIAMS.

Unions—Horizontal or Vertical?

Running separate unions for each trade in an industry is, under present conditions, not beneficial to either employer or employee. With a separate union for each craft, an employee in a large plant will have several unions to negotiate with, and arrangements made with one union may easily upset the members of another employed in the same plant, causing severe discontent. In England, in recent years, many of the smaller unions have amalgamated, with beneficial results.

Undoubtedly, a vertical union will mean more stability in a shop, though, as with a craft union, its members may have to act in sympathy with members employed in a different trade, while having no grievance of their own. A vertical union has the advantage that it can study the interest of an individual industry, whereas a horizontal union studies the interest of one craft, regardless of the industry in which its members are employed.

—W. E. WARNER,
Garden City, Hertfordshire, England.

• IDEAS •
FROM PRACTICAL MEN

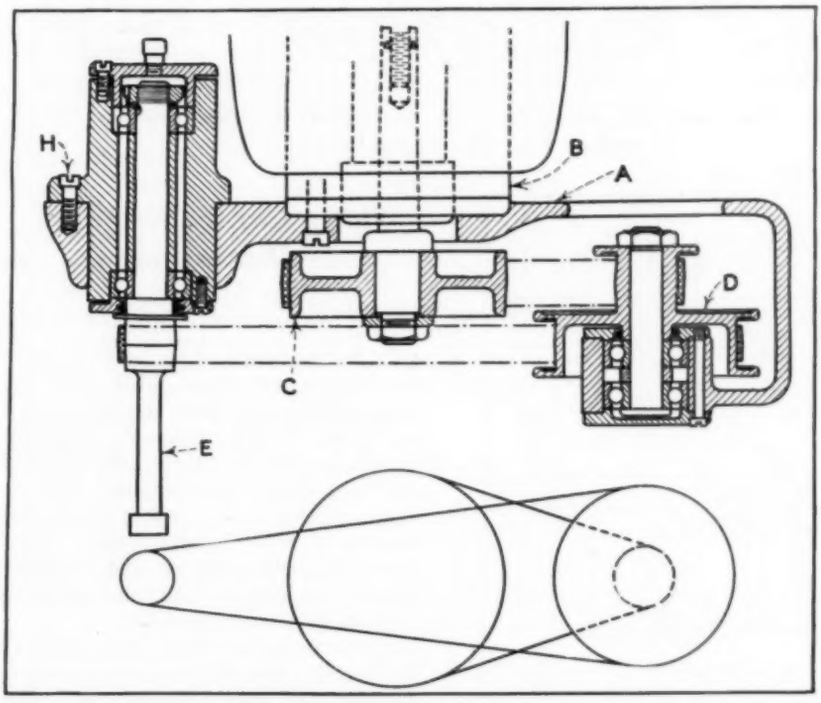
Internal Grinding Fixture As Applied to a Vertical Milling Machine

F. A. FIRNHABER

Having a large quantity of small, internal, grinding work to do and not having an internal grinding machine available, the fixture illustrated was made and attached to a high-speed, vertical milling machine having a rotary table. Either the longitudinal or the cross-feed screws were used for moving the work for sizing the holes being ground and the spindle was moved up and down for the traverse.

The light frame *A* is centered by the spindle sleeve *B* of the machine, and is attached by fillister-head screws. The driving pulley *C* is mounted on a shank fitting the taper hole in the machine spindle, and held therein by a draw-in rod. The two-step pulley *D*, which steps up the speed, is mounted on a shaft that runs in ball bearings.

The grinding-wheel spindle *E* is of the removable quill type and may be replaced by a hollow spindle to accommodate small steel burrs and grinding pencils. The spindle and its housing can be removed by taking out three screws, one of which can be seen at *H*. The ball bearings are preloaded to compensate for both working thrust and weight of the spindle. In the diagram in the lower part of the illustration may be seen the arrangement of the belts and pulleys. Light and very flexible endless belts are used, either of leather or canvas. Speeds up to approximately 50,000 r.p.m. are obtainable.



A vertical milling machine can be temporarily converted into an internal grinding machine by the use of this attachment. Very high speeds are obtainable by the system of belts and pulleys

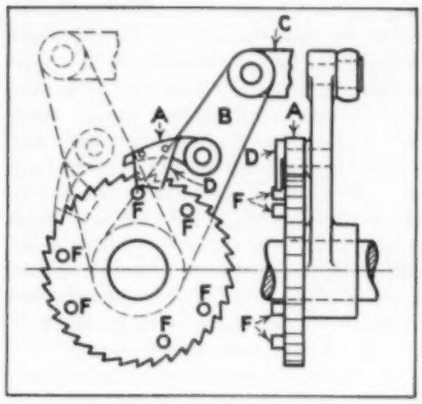
A Variable Rachet Motion

L. KASPER

The sketch shows the construction of a ratchet motion that was designed to produce variable, intermittent movement in the feed shaft of a machine for forming wire.

The pawl *A* is pivoted on the lever *B*, which obtains reciprocating motion from the rod *C*. Attached to the pawl is the cam plate *D*. As lever *B* swings to the left, the pawl engages the ratchet and partially rotates it.

On the return movement of lever *B*, the pawl drags over the teeth of the ratchet until the cam plate *D* comes into contact with one of the pins *F*, which lifts the pawl clear of the ratchet teeth. This renders part of the forward movement of the pawl ineffective, as it can not engage the ratchet until the movement of the lever causes the cam plate to leave the pin. Since the pins *F* are unevenly spaced in the ratchet, the movement of the ratchet will be variable, being greater at some points than at others. Various combinations can be obtained by changing spacing of the pins.



Different combinations of variable, intermittent movement of the shaft can be obtained by changing the spacing of the pins in the ratchet

Boring Heads and Prevention of Chatter Discussion

DONALD RAEBURN
Glasgow, Scotland

The article by J. T. Towlson under the title given above (*AM*—Vol. 77, page 509) was very interesting, particularly where the tangential setting of the tools is advocated to reduce vibration. This particular setting of the tools is preferable to using forged set-back tools where the depth of cut varies, a condition that sets up vibration to the detriment of the tools, the work and the machine. The efficiency of Mr. Towlson's method of setting the tools can be improved by grinding the cutting points of the tools slightly below their front faces, insuring a clean cut irrespective of variations in the depth of cut.

While the trailing cut gives the greatest satisfaction when applied to boring bars that are traversed by the feed gears of the particular machine em-

ployed, the design of Mr. Towlson's bar tends to raise doubts as to the same satisfaction being secured. In the type of boring bar described by him, the traverse is obtained by change gears attached to the end of the bar, and which convey motion to the boring head through a screw and a nut secured to the bar and the head respectively. With a long and comparatively slender screw driven by small change gears, the strain under a heavy and variable cut is severe. Springing must occur, and backlash in the nut is inevitable, due to wear.

For taking up effectively the backlash in the nut I suggest the following method. Secured to each end of the nut, with the object of dampening vibration, is a leather, or fiber, washer that is a close fit in the threads of the screw, and held in place by a brass washer and machine screws. Backlash can be taken up by grinding the inner faces of the leather, or fiber, washers where they bear against the ends of the nut. This arrangement also acts as a cushion against the spring of the feed screw.

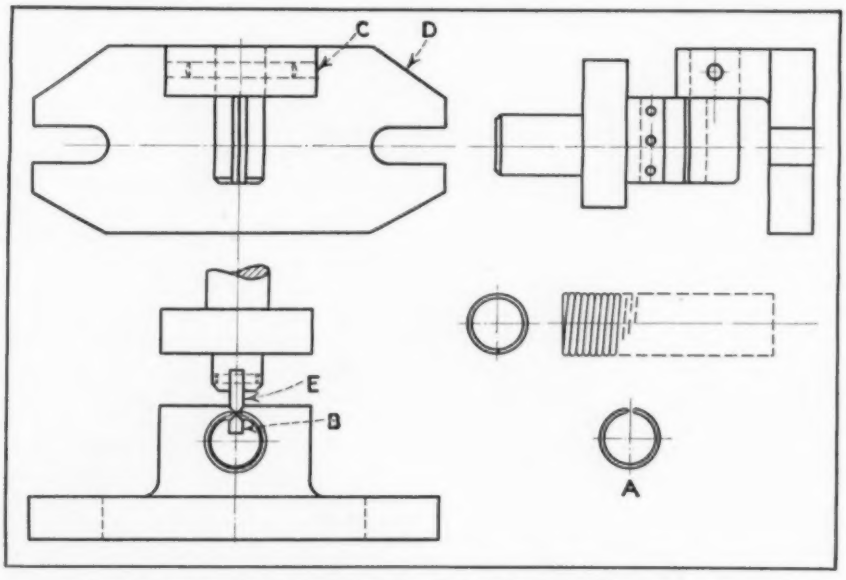
Making Split Rings From Close-Coiled Springs

H. R. SCHMIDT

We had to make a large quantity of split rings, such as the one shown at *A*. The material was first wound into close-coiled springs, the coils of which were cut off by the tools illustrated.

A mandrel, or horn, carrying the wedge-shaped cutter *B* was fitted to the vertical part *C* of the special die-shoe *D*, its diameter being such as would permit the springs to be slipped on it easily. A like cutter was secured in a slot in the punch-holder by pins, as at *E*.

In operation, one end of a length of spring is slipped over the horn and against the vertical part of the die-shoe, which acts as a stop. At each stroke of the ram, the cutters part a number of coils corresponding to their length. After each stroke, the press is stopped and the coils cut from the spring are stripped from the horn by hand. The operation is then repeated until all of the springs have been cut into rings.



Split rings were cheaply made by cutting the coils from close-wound springs by these simple press tools

Mixtures for Heating Springs for Hardening and Drawing

ELBRIDGE KENNEDY

For heating small springs for hardening, we use a mixture of equal parts of chlorides of barium and potassium. For drawing or tempering the springs after hardening, we use a mixture of equal parts of nitrates of sodium and potassium.

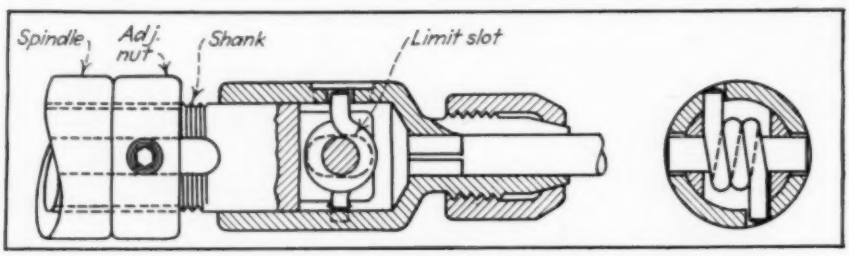
The ingredients should be melted in pots of either cast or malleable iron. The heating bath for hardening should be hot enough to heat the springs to hardening temperature. The drawing bath gives results that are superior to oil up to 600 F.

Floating Chuck for Taps

ALFRED M. WASBAUER

The chuck illustrated is for use on multi-spindle tapping machines and will permit the tap to float ⅛ in. axially in either direction, the amount of float being limited by the length of the limit slot in the chuck body. The torque is taken by the pin on which the spring is mounted. Using a spring of $\frac{3}{32}$-in. high-grade spring wire and having two and one-half coils, the maximum pressure exerted before the pin reaches the end of the limit slot is about 115 lb., being enough for taps up to ½ in. in diameter.

The holes in the sleeve are a loose fit for the ends of the spring and are flared outward to prevent cramping. To assemble the chuck, the spring ends are entered into their holes in the sleeve, then the shank is put in place and the pin is driven through.



This chuck will permit the tap to float axially in either direction to cushion it as it enters and leaves the work

Sharp Corner Grinding Discussion

M. P. DALTON
Sevenoaks, Kent, England

In his discussion of the subject under the title given above (*AM*—Vol. 78, page 193), Harry Shaw has given good advice in the first paragraph. Unfortunately, he has not taken it himself and he has clearly misunderstood what I said (*AM*—Vol. 77, page 573) in discussion of Walter Well's article. I referred to both grinding and polishing wheels, but not, as Mr. Shaw seems to assume, to precision grinding.

Further, in assuming that grinding against the side of the wheel is recommended, he has mistaken me. The straight lines on the forms were inserted only to indicate the direction of presentation of the work to the wheel. Finally, as the natural method of applying the

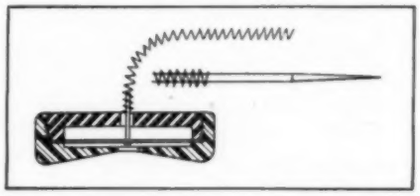
work is normal to the direction of the formed wheel-face, a step would not be worn in the side of the wheel, even if the straight lines were meant to show real contour, which they were not.

Stethoscope for Detecting Machine Noises

C. W. HINMAN

A useful noise-detecting instrument can easily be improvised from a receiver from a radio head-set. The principle of the receiver is entirely mechanical, no electrical connection being necessary. It would, however, be more sensitive if it had a carbon cup and an electrical connection back of the diaphragm, as in the telephone transmitter.

In the receiver illustrated, the original coils have been removed and a pin has been sweated to the center of the diaphragm. To the free end of the pin a



By placing the pointer against moving mechanism and holding the receiver to the ear, noises that are non-existent to the unaided ear can be heard and located

helical spring terminating in a long, pointed pin, has been soldered.

In operation, the pointed pin is held against the suspected noisy bearing or other part of a mechanism in which noises are prohibitive, such as the motors of phonographs, radio apparatus and talking picture projectors. If there is any noise it can be distinctly heard when the receiver is pressed against the ear. In this manner all squeaks, and annoying chatters can easily be located, so that measures can be taken for their elimination.

There are numerous other uses for this little stethoscope. It can be employed in the study of the cutting of metals and other materials. When the pointer is pressed against a lathe tool that is cutting, a distinctive noise corresponding to the cutting of each different material is heard in the receiver. If the material being turned is not homogeneous, but contains small blow holes or grit that cannot be detected with even a good microscope, this instrument will reveal their presence. An inaccessible bearing that has run out of lubricant can quickly be detected. Noisy gears can be located and unwarranted friction between parts can be heard.

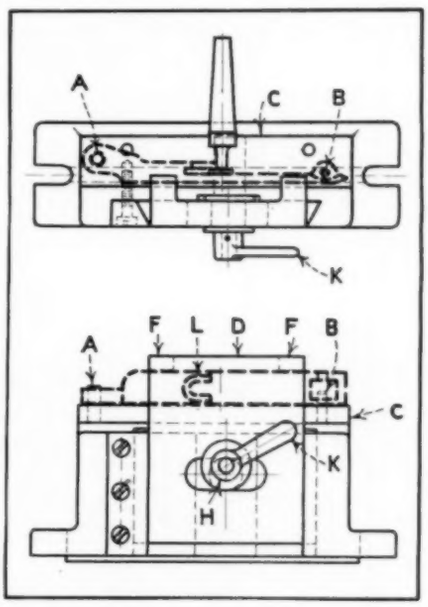
An additional proof of the sensitiveness of this instrument is to place the pointer in the groove of a revolving phonograph record. Every word of speech or song can be distinctly heard in the receiver, no matter whether the indentations are at the bottom or at the side of the groove. If the pointer is placed against the center of a sounding board or with a primary diaphragm at the receiving end of a horn, a series of interesting experiments will be made possible. The notes from musical instruments can be checked so that they can be altered to be in accord with those of other instruments. In war time, the direction of approach of a squadron of enemy airplanes can be determined, and when used in the trenches, tunneling work preparatory to placing mines by the enemy will be revealed.

Fixture for Milling Slots

F. SERVER

A fixture for holding steel parts while milling and undercutting slots in two operations is shown in the illustration. The work, indicated by heavy dotted lines, is located by the pins *A* and *B* engaging holes at the ends, the pins being held in the block *C* attached to the base of the fixture.

Essentially, the clamping arrangement consists of the slide *D*, having two hooked portions at *F;* the eccentric shaft *H;* and the hand lever *K* for operating the eccentric shaft.



This fixture is used for two operations. The work is located over two pins and is held by the hooked ends of a clamp that is operated by an eccentric shaft

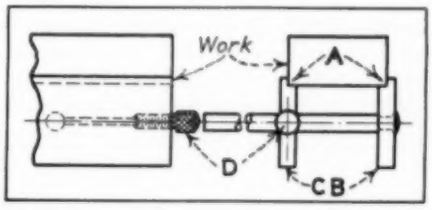
In the first operation, the slot *L* is milled in the entire batch by an end mill. In the second operation, the slot is undercut by a cutter of the T-slot type. In operating the clamp, the lever is swung to the left, causing the eccentric shaft to raise the sliding clamp so that the work can be slid under the hooks and placed on the locating pins. After loading the fixture, the lever is swung to the right, causing the eccentric shaft to lower the clamp and to hold the work securely by the hooks.

Parallels for Drilling

FRANK J. MAILE

In drilling steel quite a burr is formed where the drill comes through, and the duller the drill the bigger and heavier is the burr. Unless the work is placed on parallels, the burr will have to be removed before drilling other holes or the work will not lie flat.

In the illustration are shown improved parallels for mounting work for drilling and reaming. They may be made of tool steel and hardened, or of machine steel and pack hardened. The steps *A* should be about ⅛ in. deep and ⅞ in. wide. A piece of drill rod is riveted in a hole in parallel *B* and slides in a clearance hole in parallel *C*. Thus the parallels are adjustable for distance



The parallels can be spread apart for work of different widths. Since the work rests on the steps, the burrs do not interfere with its lying flat

apart for holding work of different widths, and they can be locked in adjustment by the knurled-head screw *D*, which bears on one end of a brass rod fitting loosely in a hole drilled lengthwise in parallel *C* and into the transverse hole for the drill rod. The opposite end of the brass rod is in contact with the drill rod and is pinched against it by turning the knurled-head screw.

In use, the parallels are spread apart sufficiently to admit the work to the steps *A* and are then locked by the knurled-head screw. Any number of holes can now be drilled and reamed in the work and the burrs will not have to be removed until after all the drilling and reaming have been completed.

Improvised Attachment for Hobbing Bevel Gears

ERNST A. BESTE

We had to machine a quantity of small bevel gears *A* that were an integral part of the aluminum disks *B*. Since the quantity did not warrant making die-castings, we made the attachment illustrated to fit one of our hand operated milling machines. The gear blanks were machined in a previous operation by an end mill formed to the correct shape for a bevel gear of 12 pitch and having 18 teeth.

Essentially, the attachment consists of the base *C*, to which the side plates *D* were welded to support the housing for the work spindle at the correct cutting angle; the tapered work spindle *F*, running in a bronze bushing and driven by worm gearing through chains, sprockets and spur gears, the drive being taken from a sprocket on the cutter arbor.

Due to the small amount of clearance between the gear blank and the face of the disk, it was necessary that the hob *H*, which has a single thread of Acme form, should not be more than 1 in. in diameter. The outboard end of the cutter arbor is supported by a center in the overarm bracket in the usual way.

In operation, the attachment is mounted on the machine table in line with the helix angle of the hob, and with the work in place, the table is gradually raised until the correct depth of cut has been reached. The hob is run at a surface speed of 150 ft. per min. and the actual cutting time is 25 sec. for each gear. Loading is simply a matter of screwing the combined disk and gear blank onto the threaded end of the work spindle. The action of the pivoted mountings for the chains and sprockets permits moving the table sufficiently for loading and unloading without disturbing the set-up. The floor-to-floor is less than one minute per gear.

The gears hobbed by this attachment are of the straight, bevel gear type. While the teeth were slightly thinner and longer in the middle of the face, the gears were entirely satisfactory for the purpose served.

A Pot Chuck for Holding Small Crankshafts

A. L. HARTLEY

The pot chuck illustrated was designed to provide a means of holding and clamping small single-throw crankshafts by the cheeks while turning the pins. It provides an accurate means of chucking the work.

Previously turned and faced on the back of the cheek, the crankshaft is placed in the bushing *A*, which is in halves, and is rotated until one side of the cheek is in contact with the locator *B*. The hinged cap *C* is then closed and clamp bolt *D*, pivoted on the clamp stud *F* is swung into position. When the nut on the clamp bolt is tightened, to close the halves of the bushing tightly the pivoted clamp stud is drawn upward, bringing the clamp jaw *H* against the free side of the cheek and holding the cheek firmly against the locator. At the same time, the hinged cap is closed on the straight part of the shaft, holding it securely. By this means the crankpin is correctly located.

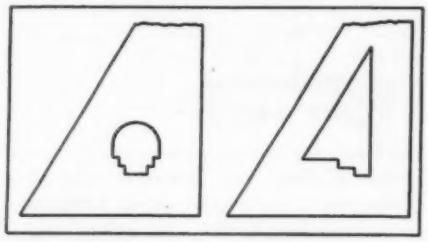
Drawing Lines for Lettering

H. J. PARRISH

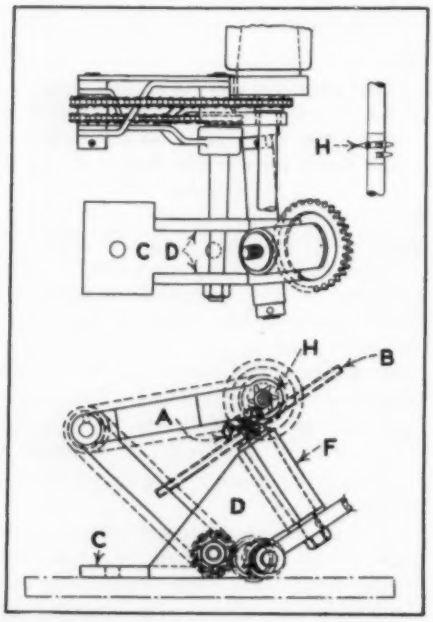
Hillingdon, Middlesex, England

If the opening in a small triangle is filed in steps of the required depth, as shown in the illustration, the pencil point can be placed in the corner of one of the steps and the pencil and the triangle can be slid along the T-square, drawing a line. Lines parallel to the one just drawn can be drawn in the same manner by placing the pencil point in the corners of the other steps.

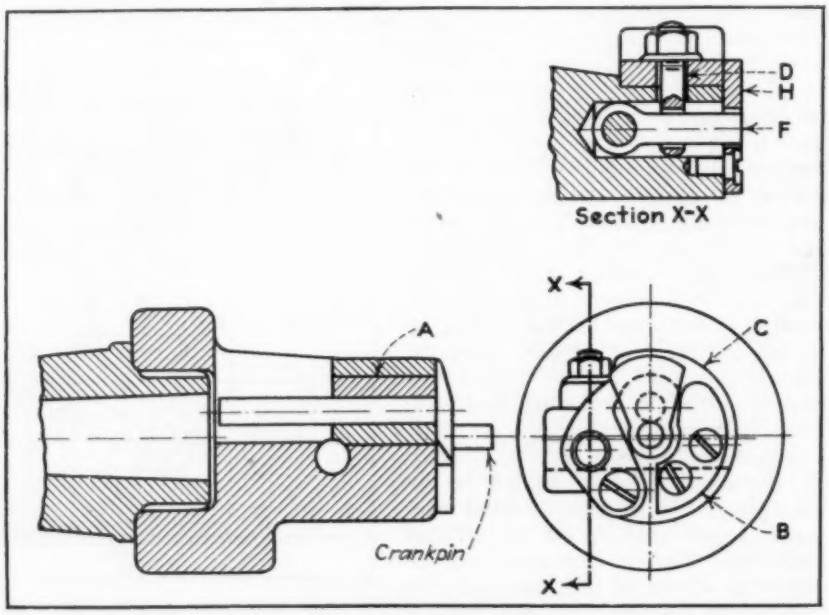
Two examples are illustrated, one triangle having a round opening, while the opening in the other is triangular. The depths of the steps are made to suit the heights of the letters to be drawn.



Parallel lines for lettering can be drawn by placing the pencil point in the corners of the steps and sliding the pencil and the triangle along the T-square



Small bevel gears were hobbed by this attachment mounted on a hand miller in less than one minute each, floor-to-floor



Crankpins of small single-throw crankshafts are located in this chuck for machining by clamping the shaft in a bushing and holding one edge of the cheek against a locator

Center Punching on Scribed Lines Discussion

GEORGE J. MURDOCK

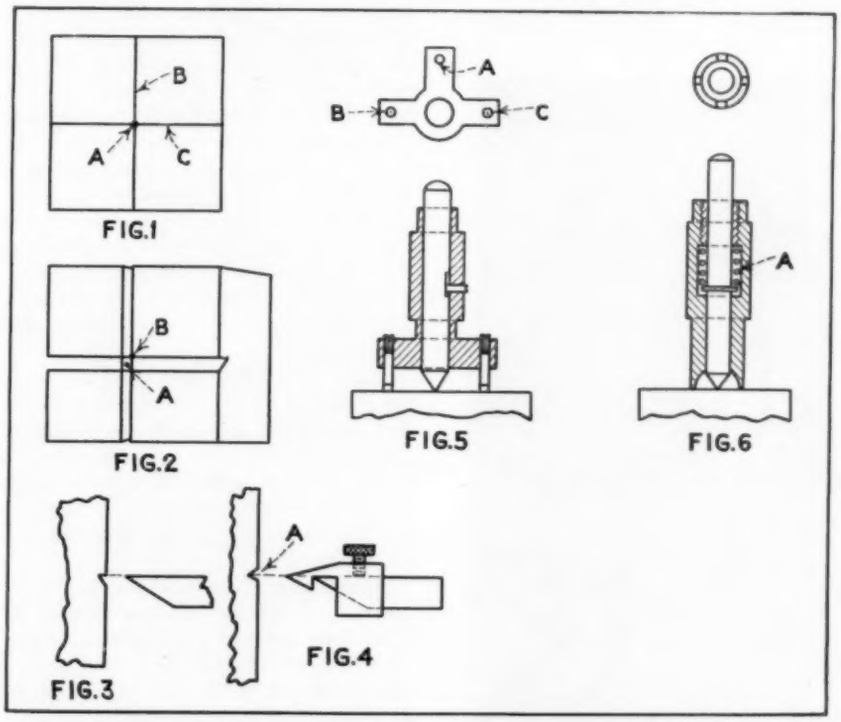
In an article under the title given above (*AM*—Vol. 78, page 193), C. W. Castle describes a device for center punching the intersection of lines scribed at 90 deg. Presumably, the lines were scribed with an ordinary height gage. While, theoretically, such a procedure appears to be right, some difficulties enter into the problem.

To illustrate, it will be assumed that a hole is to be bored at the intersection *A* of the lines *B* and *C* in the steel block in Fig. 1, and that the lines have been scribed by a height gage having the type of scriber ordinarily used. When these lines are greatly magnified, they will appear as in Figs. 2 and 3, and the point of the center punch will be deflected, striking at *A* instead of at *B*, thus introducing an error that, while small, will interfere with accuracy in locating the block for boring the hole.

We made such a block as described by Mr. Castle, but found it difficult to grind the knife edges accurately at right angles to each other and with the angles alike. Besides, the knife edges were so short that it was almost impossible to get them into the shallow lines with certainty. To obviate these difficulties, we made a scriber to be attached to the scriber on the height gage, as in Fig. 4, so that it would scribe a line as at *A*. We also made a block having a knurled sleeve to support the center punch vertically, and carrying three knife-edged pins in its base, as in Fig. 5. The pins were a tight fit in the base, but could be adjusted vertically by the small screws shown, so that the center punch could be squared up. By placing the knife edge of pin *A* in one line and pushing the block along until the knife edges of pins *B* and *C* engaged the other line, the center punch was in the correct position, and when tapped with a hammer its mark was at the intersection of the lines.

The mark thus made checked up very accurately with the sides of the steel block, but it was too small for best results. Then a follow punch to enlarge the punch mark was made, as in Fig. 6. The sleeve rested on four feet milled in the bottom. The spring *A* held the center punch down so that its point was slightly below the feet.

In use, the point of the punch is placed in the small mark made by the first punch. Since the spring holds the punch firmly in place, it is easy to square the sleeve on its feet and then strike the punch with a hammer, enlarging the mark without interfering with the accuracy of the mark made by the first punch. The hole can then be bored as accurately as if it had been located by buttons, and the time for preparation is much shorter.



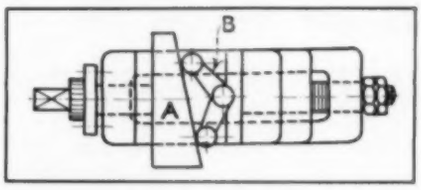
Showing how the error caused by scribing the lines with a height gage fitted with the usual type of scriber was avoided. Devices for accurately center punching the intersection of scribed lines

Holding Tapered Work in the Machine Vise

J. T. TOWLSON
London, England

Tapered work can be securely held in the machine vise by the method illustrated. Pressure on the work *A* is equalized by the triangular steel casting *B*, which is pivoted in a groove in a false jaw attached to the movable jaw.

By arranging the tightening screw of the vise as shown, it can be changed end for end if desired for convenience in operating the vise from either end.

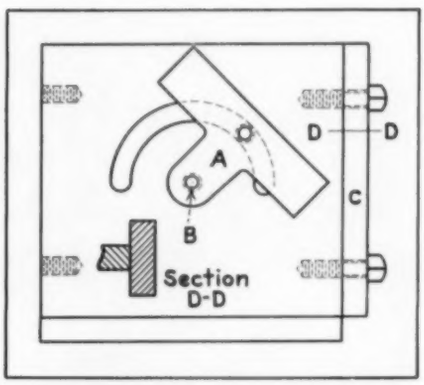


The triangular casting placed against tapered work and pivoted in a false jaw will equalize the pressure and hold the work securely

A Convenient Angle Plate

WILLIAM F. GATZ
Joliet Machine Shop

The angle plate illustrated is intended for use on the toolroom surface grinder. It consists of an ordinary angle plate, machined all over; the swiveling piece *A*; pivoted at *B*; and the side piece *C*, which can be attached to either side. A semicircular slot is cut in the vertical



Work clamped to the swiveling piece can be ground at any angle within 90 deg. either way from the vertical

member for the bolt that clamps the swiveling piece.

Work clamped to the swiveling piece can be ground to any angle within 90 deg. from either side of the vertical. Work stood vertically and clamped to the side piece on either side of the angle plate can be ground square on the end.

SHOP EQUIPMENT NEWS

Heald No. 73 Airplane Cylinder Grinder

The Heald Machine Company, Worcester, Mass., has brought out an internal grinder arranged with a hollow workhead for grinding single airplane cylinders, long sleeves and work of similar nature. This machine is known as the Style No. 73. As an airplane cylinder is bolted to the engine by the flange and centralized by the turned diameter of the skirt, the fixture was designed to locate from these surfaces in order that the bore could be ground at right angles to the flange and concentric with the outside diameter of the skirt.

In chucking the cylinder, an adapter ring is first bolted to the flange, then a bracket with a stud is fastened to the rear. The cylinder is loaded into the workhead from the left-hand end and is centralized by six locating pins. Guide bars guide it into position. The adapter ring is then clamped against three positive stops by hook clamped bolts operated from the front to lock the cylinder into the workhead so that the bore is concentric with the centerline of the workhead and square with the flange. A strap with a self-aligning end support is then slipped over the stud on the bracket at the rear and clamped to the workhead spindle. This acts simply as a support and steadyrest against the wheel pressure and does not affect the alignment or location. Two adapter rings and brackets furnished with each machine enable the operator to prepare a cylinder while another is grinding.

The general design of this machine is similar to other internal grinders built by the Heald company. The base, however, is much heavier and with wider table ways which are pressure lubricated. The oil used in the hydraulic system for driving the table is inclosed in the base, keeping it free from grit.

On this machine all switches and other electrical connections for the various motors are contained in one terminal box mounted on the front of the base. An inching switch permits the wheel spindle to be jogged around while setting up the machine.

The table is driven by the usual Heald hydraulic drive. The workhead carries a hollow spindle mounted on two special, precision ball bearings and is of such construction as to permit copious lubrication, but water, dust and other foreign substances are kept out. The hole in the spindle is 10 in. in diameter, providing room for all standard single airplane cylinders. The V-belt drive between the workhead motor and the work spindle is connected through a double pulley mounted on an adjustable jackshaft, making it possible to keep tight both the belts to the workhead and from the motor. With this type of a driving connection all vibration that might be produced from flexible idlers is eliminated.

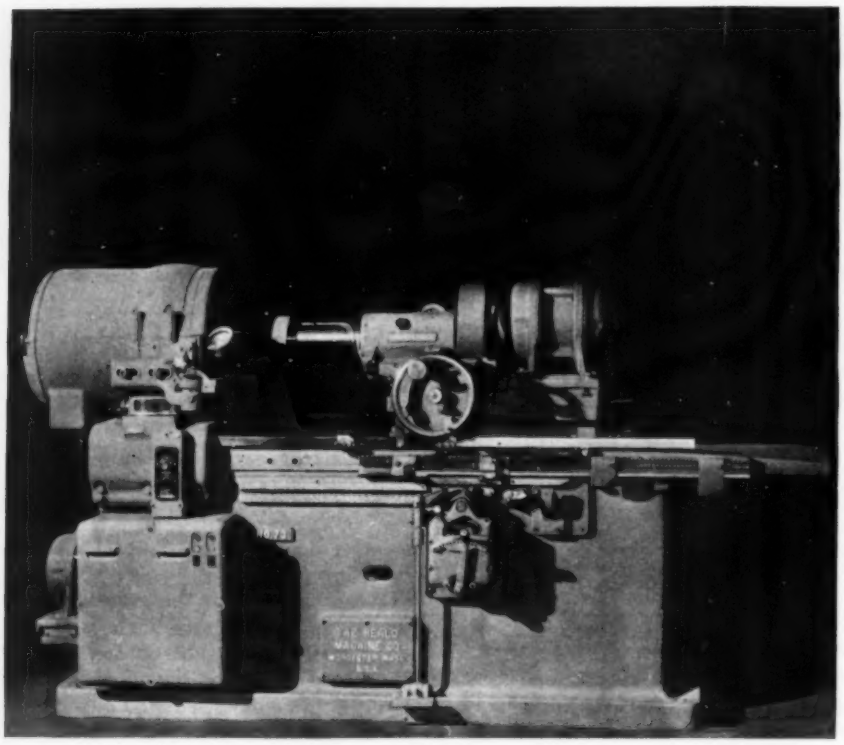
Vibration Minimized

The workhead drive motor is mounted on a suitable base plate that is carried on vibration dampeners. A solenoid brake prevents excessive over-run.

The cross-slide has been made larger and heavier. A 10-hp. motor is mounted on the cross-slide base separate from the cross-slide, preventing the transmission of vibration to the wheel spindle. In order to maintain the proper belt tension, the motor and cross-slide move together when feeding the wheel into the work. Drive to the wheel spindle from the motor is by belts through a jackshaft that is adjustable for belt stretch. The wheelhead is of the Heald Red Head design.

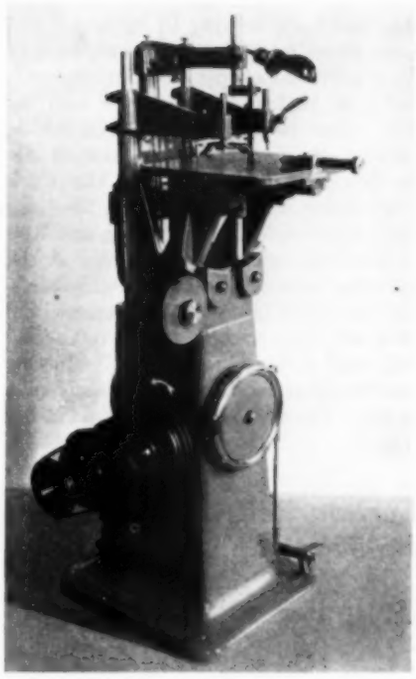
The main drive motor and oil pump are mounted on a base plate that is carried on vibration dampeners similar to the workhead motor. An oil pump is driven through a flexible connection direct from the motor shaft. A tank for 110 gal. of coolant is placed at the rear of the base.

Specifications are as follows: length and width of base on floor, 88x31 in.; total floor space, 126¼x76½ in.; center of workhead spindle from the floor, 50 in.; workhead speed, 100 to 200 r.p.m.; hole in spindle, 10 in.; table speeds, 0 to 44 ft. per min.; on average cylinders, holes 10 in. long can be handled; net weight, 10,500 lb.



Surface Broaching with Indexing Fixtures on Foote-Burt Continuous Machines

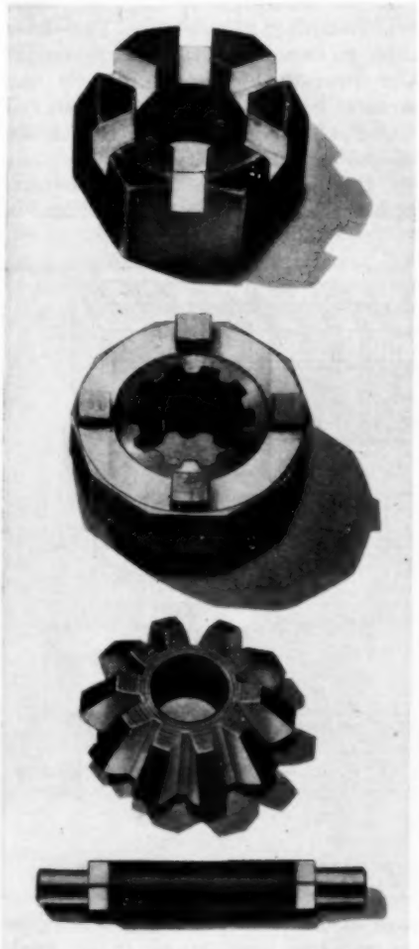
The Foote-Burt Co., Cleveland, Ohio, is now using indexing fixtures on its continuous-type surface broaching machine. The illustration at the right shows a set-up for squaring both ends of a spring shackle pin, this part being shown at the bottom of the illustration at the left. The pins pass through the first set of broaches at the right-hand end, and two flats are broached on each end. Broaches are located both above and below the fixtures. After this cut the groove in the top plate of the fixtures engages the indexing pin in the top half of the broach holder shown swung back. The indexing pin gives the work-holding spindle a quarter turn and the work then passes through the remaining straddle broaches, completing the squares. Each pin is ejected automatically from its fixture. The cam block, which is the second piece in the illustration at the left, is handled in much the same manner. The part goes through the machine once, two broaches being used. With pieces such as the gear and the castellated nut, the part necessarily has to make more than one pass through the machine and is automatically unloaded after the cuts are completed.



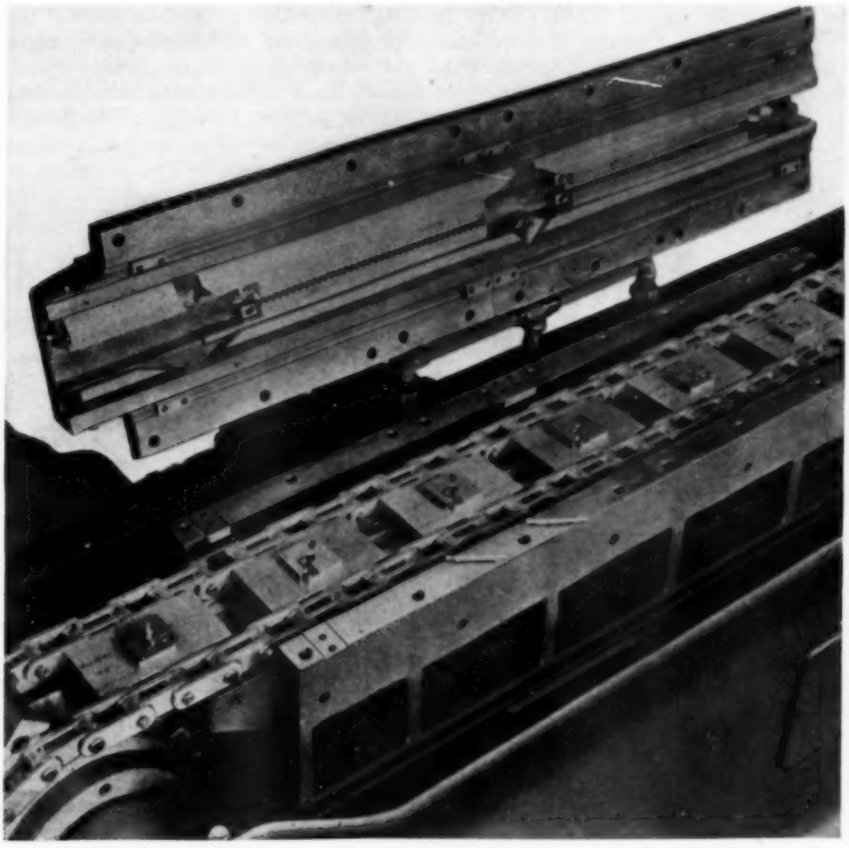
Oliver Heavy-Duty Filing Machine

Sawing or filing metal up to 3 in. in thickness, or filing still heavier material with a shorter stroke, can be done on the heavy-duty die-making machine developed by the Oliver Instrument Co., Adrian, Mich. The stroke is adjustable from 0 to 5 in., and the six speeds range from 100 to 300 strokes per minute. Any parallel file or any size saw from the smallest to the heavy machine saws can be held in the clamps. Saw guides are provided above and below the table, and both can be removed or adjusted. A continuous blast of air keeps the work clean.

The ram that reciprocates the cutting tool is made of steel tubing 2 in. in diam-



Right—Fixtures index after they have traversed the first set of straddle broaches so that an additional cut can be taken by the second set of broaches. Left—Typical parts broached with indexing fixtures



eter and has a bearing 10 in. long. The arms which reciprocate the cutting tool have universal clamps, adjustable vertically, so that the file or saw may be held close to the work. A hydraulic feeding device relieves the saw or file on the upstroke and feeds the work while filing. If left to itself, the machine will feed a short distance and stop so that the work is not spoiled if the operator leaves the machine without attention. The table is 14 in. square and tilts 15 deg. to the front, right and left, and 3 deg. to the rear. Starting and stopping is effected by means of a pedal. Power is supplied by a ¾-hp. motor.

Carlton 9-in. Column Radial Drill

The Carlton Machine Tool Co., Cincinnati, Ohio, has added a small size radial drill to its line, namely, a 3 ft., 9 in. size. This small radial drill also has the company's low-hung drive to the spindle, in that the drive comes down under the arm and is applied to the largest diameter of the spindle, close to the work. Twelve changes of speed are provided, covering a range of 80 to 2,000 r.p.m., or 120 to 3,000 r.p.m. Six changes of feed range from 0.006 to 0.025 in. per revolution of the spindle. Automatic stops control the maximum spindle travel both up and down, and a dial can be set for travel to any predetermined depth. Drive to the spindle is through multiple-disk clutches. Reversal can take place at any speed almost instantaneously.

In the head there is a pump for lubricant. Anti-friction bearings are employed throughout, and all gears are made of special alloy steel, heat-treated. The arm is elevated up and down on the column by a revolving nut that takes power from the main driving unit at the back of the arm. Automatic stops control the maximum travel of the arm up and down, and a single lever is used for raising and lowering the arm. A column lock is provided.

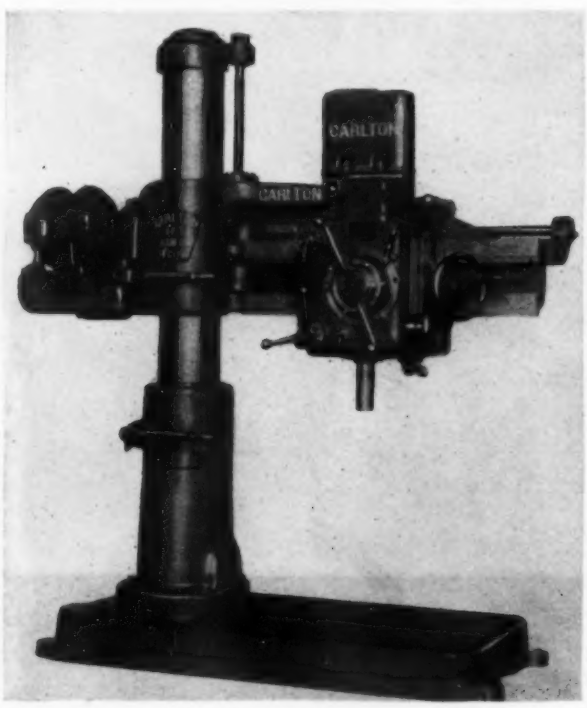
Jones Magnetic Jig Blocks

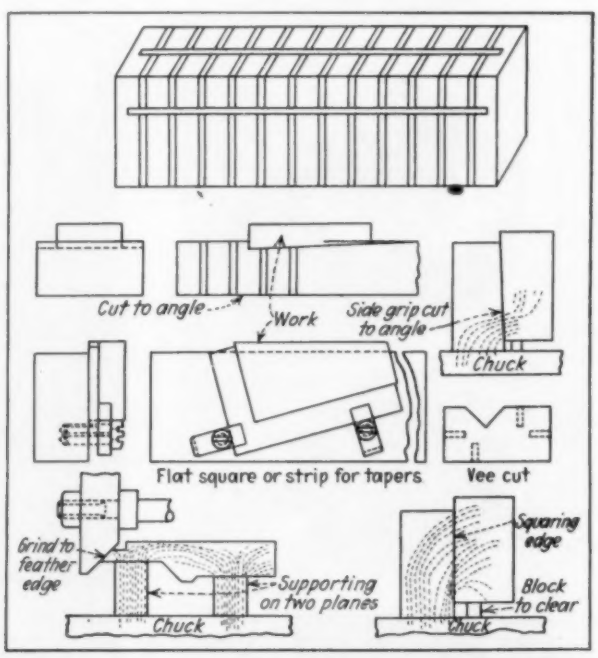
The Barker Tool, Die & Gauge Co., 5529 Ellery Ave., Detroit, Mich., is manufacturing an assortment of auxiliary jig blocks, patented by David Jones. These magnetic work-holding devices can be made in the shapes or forms illustrated, or in other types as either the magnetic elements or the pole separators may be cast as best suited to requirements. The devices may be used as a magnetic jig or top plate for magnetic chucks in connection with a magnetic field produced by any suitable means.

Referring to the illustration, the parallel shown at the top is composed of pole separators and spacing bars that act as magnetic edges to retard sidewise movement. These separators and spacing bars are cast one within the other. The blocks offer a method of setting up without using the cross room of the table or interfering with the spindle bearing or wheel, at the same time keeps the work from flying off the chuck. Angular or irregular shapes are readily made from standard parallels. The view below the standard parallel shows one cut to an angle, whereas the view to the right illustrates one for grinding at an angle and gripping on the side. Parallels may have a V cut. At the left of the V-block is a flat square secured with clamps and holes drilled and tapped for screws. This square may be replaced with other forms, strips for locators. The view at the bottom left shows the method of cutting a feather-edge while supporting the part by surfaces in two different planes. This is accomplished with parallels of different heights, and wheel clearance is secured. The view at the right shows a rest block that serves as an insulator, allowing the flux from the side of the block to grip the work. In this case the operation is to square the edge of a rectangular piece. Distribution of flux through an alteration in the surface area or the winding adjustment permits the required latitude in making up blocks for special holding applications.

Improved "Sta-Put" Lubricants

E. F. Houghton & Co., 240 West Somerset St., Philadelphia, Pa., have made an improvement that increases the film strength of its line of oils and greases bearing the trade name of "Sta-Put." When first developed the oil had increased ability to stay in place by treating it with selected mineral hydro-carbons. Now the addition of





Typical applications of Jones Magnetic Jig Blocks for holding work for grinding straight or at an angle

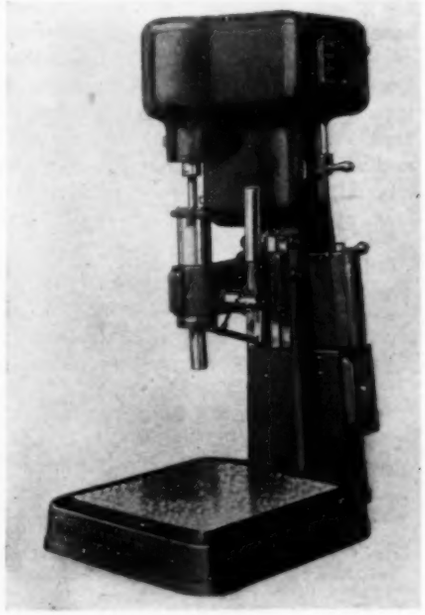
certain other hydro-carbons increases the load-carrying capacity. It is said the shock loads or sudden reversals on a bearing are met with comparatively light oil, and without the addition of materials that cause change in the appearance or ability to be used as other mineral oils are used, and without deterioration or thickening in use or storage.

Six Grades Added by Carboloy

The Carboloy Co. Inc., Detroit, Mich., has developed six additional grades of Carboloy cemented carbide. These additions supplement the six existing grades, and have been developed primarily to obtain improved performance in special fields of application. Among these applications are: rough and finish boring, finish turning and facing of steel brake drums; single-point finish boring of steel connecting rods; re-boring of automotive cylinders, and turning, facing and boring of piston rings. The six grades are designated as 715, 831, 883, 905, 906 and 907.

Redin No. 200 Sensitive Bench Drill

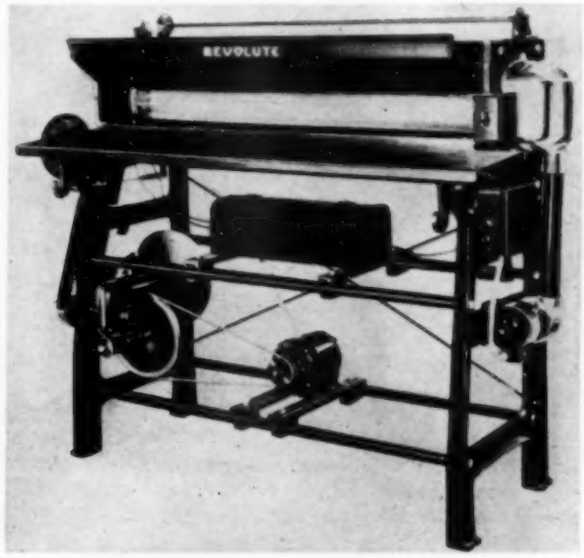
Another sensitive drill with a rolling-wedge transmission has been built by A. W. Redin & Son Machine Co., 1846 Eighteenth Ave., Rockford, Ill. This No. 200 drill has eight speeds ranging from 395 to 3,700 r.p.m., in geometrical progression. The capacity ranges from 0 to 5/8 in. in cast iron. Speeds are easily obtained by quick-shift levers. The base has a working surface of 240 sq.in., and has a large bearing on the column. Fully inclosed ball-bearings are used throughout.



Photographic Printer

For reproducing pencil tracings on sensitized tracing cloth a No. 7 photographic printer has been developed by the Paragon-Revolute Corp., 77 South Ave., Rochester, N. Y. The machine will reproduce to the same size any one-sided copy that is semi-translucent in the same manner as a camera would reflect light through a lens. However, the principal use of the machine is to produce tracings of pencil drawings by means of a photographic process, utilizing a sensitized translucent cloth. Thus, the production of inked tracings from pencil drawings is avoided, saving time and avoiding errors in tracings.

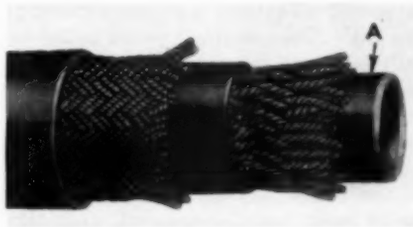
The use of the above sensitized cloth requires uniform printing and good contact, in order that every line, figure or character can be reproduced exactly as it appears on the original. Consequently, the No. 7 machine is provided with an adjustable aperture extending across the exposing area that can be varied from 1/8 to 3/8 in. in width. As the machine is used in a dark room, audible adjustments are provided. The speed of the revolving Pyrex cylinder may be varied from 4 in. to 20 linear ft. per min. Thus, the speed range is ample for all classes of photographic materials that are suitable for this type of reproduction work. The photographic prints made on the machine are developed, fixed and washed in a maner similar to photo-copy prints of the ordinary snapshots.



Tracings on sensitized cloth direct from pencil drawings, white background prints from blueprints, or a tracing of a part or detail from an assembly drawing, can all be made on the Revolute No. 7 Special-Purpose Printing Machine

"Electric" Type DB Paint Fluid Hose

The Electric Hose & Rubber Co., Wilmington, Del., has developed a Type DB paint fluid hose with inner tube *A* made of a special compound possessing the strength and flexibility of rubber, but being free of the usual tendency to soften, slough off, or disintegrate when in contact with oils or solvents. The hose is of braided and molded construction and the cover is made to resist wear. The sizes are 1/4, 5/16, 3/8, 7/16 and 1/2 in. inside diameter. Any length up to 500 ft. can be furnished.



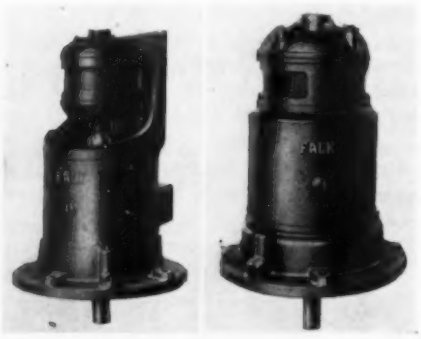
Oxweld Type C-24 Cutting Blowpipe

A general-duty cutting blowpipe, known as the Oxweld Type C-24, has been developed by the Linde Air Products Co., 30 East 42nd St., New York, N. Y. If necessary, this blowpipe is capable of doing heavier work and it is said to operate with less oxygen pressure than any preceding Oxweld cutting blowpipe. Design features are: im-

proved cutting oxygen valve, placed in an easily accessible position; a long external cutting valve lever which easily operates with the hand in normal gripping position, nozzles with seat protectors; closer spacing of the heating orifices about the cutting oxygen opening; new nozzle sizes; interchangeable large-capacity ball-type inlet-needle-valves; and interchangeable low-pressure injector or medium-pressure mixer.

Falk Vertical Motoreducers

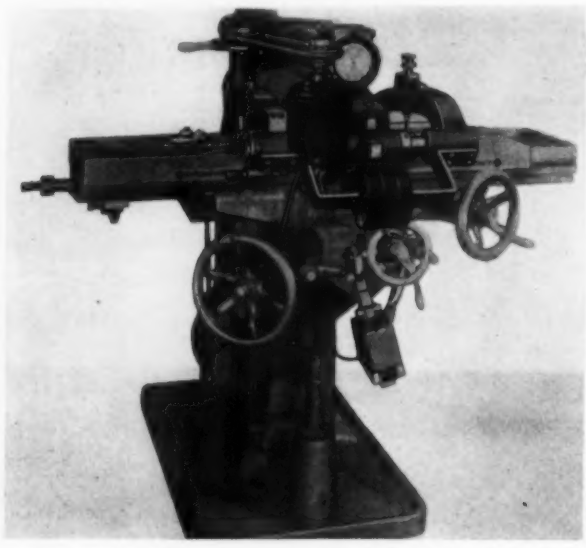
The Falk Corp., Milwaukee, Wis., is introducing a line of vertical "Motoreducers" comprising the Types IX, ZX and LX. These vertical motor reducers are available in sizes from ¾ to 75 hp., and ordinarily 1,750 r.p.m. motors are considered standard. The Type IX is for double or triple reduction, and corresponds to the figure shown at the right of the accompanying illustration. One motor end bell is removed and the stator is close coupled through an adapter to the gear case. This makes a compact design. The Type ZX uses any standard horizontal, ball-bearing type motor with feet, with resilient connection through Falk Bibby coupling to the gearing. The Type LX, not shown, is for single reduction only (1.5 to 9.0) and corresponds to the company's Geared-Head "L" Horizontal Motoreducer.



Left—Falk Type ZX Vertical Motoreducer has pressure lubrication. Right—Type IX reducer with motor stator close-coupled to gearing

Cleveland Profiling and Die-Sinking Attachment

The Cleveland Profiling Machine Co., 302 Finance Bldg., 750 Prospect Ave., Cleveland, Ohio, has been formed to manufacture a profiling and die-sinking attachment for milling machines. The attachment is placed on the overarm in much the same manner as an arbor support. Two arms extend from a hinged shaft supported on taper roller bearings. These arms are rigidly connected, their extremities being directly between a follower and a cutting tool so that there can be no movement of one that is not accurately reproduced by the other. The table of the machine is elevated so that the follower and cutting tool are in a vertical position, the arms in the horizontal position and the point at which the work is done is in a horizontal line with the center of the hinged shaft. As the table moves back and forth the follower, being sensitively mounted on taper rolls, rides the pattern and the cutter reproduces the pattern. Automatic stops are adjusted to accommodate the range of work being done. When these stops are contacted an electric magnet is energized. The work is fed laterally and simultaneously with reverse movement of the table. Positive mechanical movements operate the structure so that no damage will be done to the work should the magnetic cross feed fail to function. The cutter spindle is driven by belt.



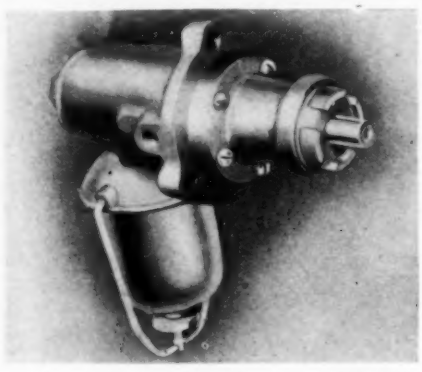
Built to suit the make of milling machine involved, the Cleveland Profiling and Die-Sinking Attachment is carried on the overarm. A magnetic cross feed operates simultaneously with the table reversal

"EC&M" Type 20 Motor Starter

For motors up to 15 hp., 220 volts, and 30 hp., 440-550 volts, the Electric Controller & Mfg. Co., East 79th St., and Woodland Ave., Cleveland, Ohio, is offering a Type 20, weatherproof and dust-tight motor starter for across-the-line service. This oil-immersed starter is inclosed in a bonderized case of black enamel. When desired, a self-contained ammeter in a dust-tight case can be applied to the top. The starter is arranged for remote control, pushbutton, or automatic operation.

Sundstrand Automatic Fuel Unit

For industrial applications, including use in connection with heat-treating furnaces, an automatic fuel unit has been developed by the Sundstrand Machine Tool Co., Rockford, Ill. This pump is suitable for all small capacity industrial applications where oil heat is being used, and should be considered the same as any oil pump. It is designed for pressure atomizing oil burners. The unit



consists of a variable-displacement pump and a strainer, the pump automatically taking care of the work done by valves, thus entirely eliminating all valve mechanism. The pump discharges with no by-passing only as many gallons of fuel per hour as is determined by the nozzle size. Automatic air release or air bleed is incorporated. Features are said to be: full pressure and volume at the start of combustion; instantaneous and positive cut-off of oil to the nozzle without dripping; mechanical seal, and pressure adjustment.

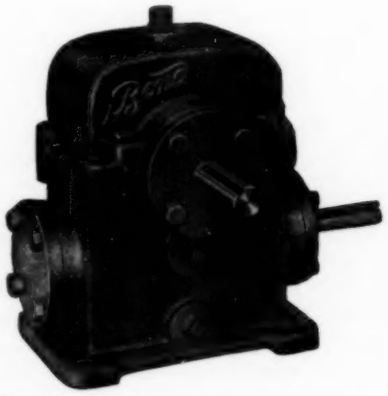
Bond Worm-Gear Speed Reducers

The Charles Bond Co., 617 Arch St., Philadelphia, Pa., has placed on the market a complete line of speed reducers for use with fractional horsepower and small motors. The Type K horizontal unit has the worm above the wheel. Timken Bearings are used on both high- and low-speed shafts. Ratios are 7½ to 1, to 48 to 1 in four sizes, the motor sizes being from ⅛ to ⅛ hp. A Type PK Unit is offered for intermittent use.

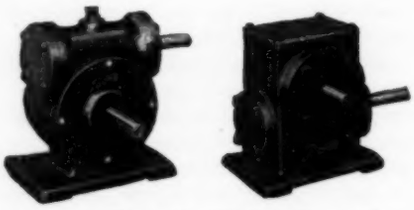
Type M horizontal unit has the worm below, is recommended for continuous operation, and has the same features as Type K. Three sizes are built, the ratios being 5 to 1, 10 to 1 and 20 to 1, and the input ⅛ hp. in each case. A Type PM unit is similar, but is not recommended for continuous service. A Type PR unit is of the same general construction, but the worm wheel shaft is double-ended.

The Type B horizontal reducers are equipped with Timken bearings and are made in a much larger range of sizes than any type in the line. Typical ratings follow: at 1800 r.p.m.: BE-10 (10 to 1 ratio) 0.90 hp.; BF-12 (11¾ to 1 ratio) 1.60 hp.; BG-12 (12½ to 1 ratio) 2.50 hp.; BH-10 (10 to 1 ratio) 5 hp. This reducer is also made in a vertical model.

A Q Type unit with the worm below is suitable for continuous operation, but has a somewhat lower capacity than the BE series unit. Motor sizes recommended are ⅓ to ⅛ hp. DN units are of a double-reduction type, ratios being 25 to 1, to 400 to 1, and the motors recommended being 1/30 hp. in each case. Rated torque output at 1800 r.p.m. ranges from 40 to 42 in.-lb. Other double-reduction types are available.



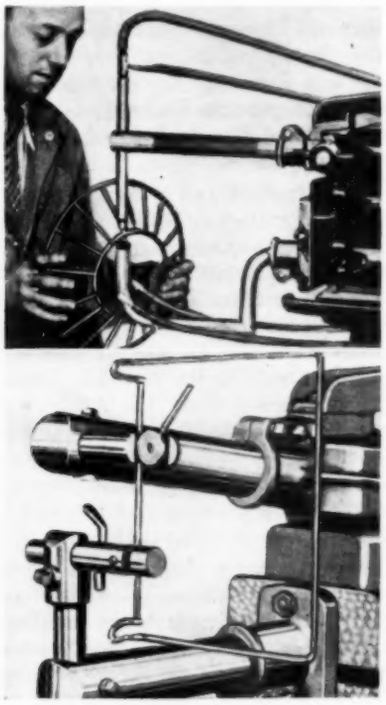
Type B, the leader of the line



Left—Type K; Right—Type M

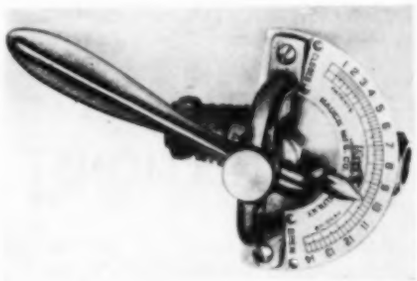
Eisler Butt Welders for Wire

Wire welders in several types have been added to its line by the Eisler Electric Engineering Co., Inc., 740-770 South 13th St., Newark, N. J. These welders have been designed especially for butt welding of wire and are used for manufacturing various novelties of brass, bronze, copper from round or square rod and wire. When furnished mounted on movable pedestals, they may be easily transported about the plant. Special annealing and quick pressure-adjustment devices enhance the operating efficiency.



Hauck Micro-Regulating Valve

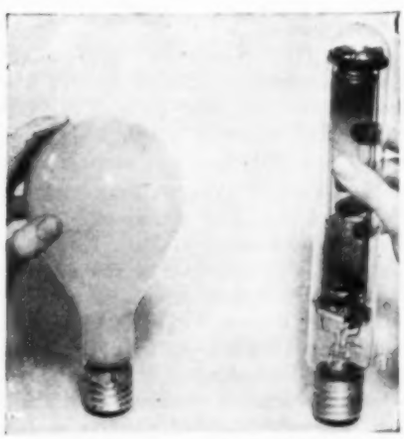
For regulating oil flow to burners for industrial heating processes a micro-regulating type of valve has been developed by the Hauck Manufacturing Co., 126-134 Tenth St., Brooklyn, N. Y. This valve is said to be suitable for either high or low pressure burners, and



all grades of oil can be used. The ring seat has a triangular-shaped opening in the side, whereas the cup-shaped valve plug has a rectangular slot, at right angles to the opening in the seat. Flow depends upon the position of the rotating valve plug in relation to the triangular slot in the ring seat. The area of this orifice is increased or decreased by minute increments as the valve plug is turned. It is said at the smallest opening a free orifice is maintained through which sediment passes readily. The valve is operated by lever handle. Automatic control mechanism can be applied.

Westinghouse High-Pressure Mercury Lamp

A light source known as the high-pressure mercury lamp has been developed by the Westinghouse Lamp Co., East Pittsburgh, Pa. When used in combination with standard tungsten-filament lamps, the combined light of



Comparative size of standard 500-watt Mazda lamp and the Westinghouse High-Pressure Mercury Lamp

these two light sources is close to that of daylight in color. The first application of the high-pressure mercury lamp was at the Ford Building at the Chicago Fair, so that the cars in the indoor display would appear to visitors just as they do in daylight. An application of the high-pressure mercury lamp is the inspection of parts where the improved lighting permits ready detection of flaws and allows general inspection with greater ease and speed.

• TRADE • PUBLICATIONS

ALUMINUM PAINT. A method of paint appraisal entitled "Buy It By the Foot" has been published by the Aluminum Industries, Inc., Cincinnati, Ohio, which produces a "Permite" aluminum paint. The booklet illustrates the various types of jobs on which this type of paint may be used.

FIBRE. A price list effective May 28, 1934, has been compiled by the Wilmington Fibre Specialty Co., Wilmington, Del. Sheets, rods, tubes, and "Fyberoid" (fish paper) are listed.

FIBRE. A finely illustrated booklet is being distributed by Taylor & Co., Inc., Norristown, Pa., describing briefly its plant devoted to the manufacture of vulcanized fibre and phenol fibre. The booklet stresses modern equipment used in this mill and illustrates the care which is taken in the plant processes.

JIGS AND FIXTURES. A 12-page illustrated pamphlet entitled "The Design of Jigs and Fixtures," published by the Linde Air Products Co., 30 E. 42d St., New York, N. Y., shows how to design jigs and fixtures for welding, whether it be for production fabrication or repair work. Photographs and sketches show every point.

MATERIAL HANDLING EQUIPMENT. Two pamphlets published by the Barrett-Cravens Co., 3255 W. 30th St., Chicago, Ill., describe respectively, lift-trucks and platforms, and storage racks.

MECHANICAL POWER TRANSMISSION. Published by the American Leather Belting Association, 41 Park Row, New York, N. Y., and priced at 25 cents, is a mechanical power transmission book written by Robert W. Drake. The book consists of 224 pages, 8½x11 in. size, with 120 illustrations. It consists of a series of 50 reports covering driven loads, load characteristics of electric motors, fundamentals of belt transmission and belt efficiency. Tables and charts are given for selecting belt sizes for open drives. A critical analysis of operating conditions of short center drives is included.

METAL CONVEYOR BELTS. The Wickwire Spencer Steel Co., 41 East 42nd St., New York City, has published a handbook on conveying problems under abnormal conditions and how they are handled with its metal conveyor belts. Particular reference is paid to conveying work under high temperatures and adverse atmospheric conditions such as in heat-treating. Washing, drying and enameling of stamped metal parts are also considered.

PLATING. An operating manual for copper, brass, bronze, and zinc plating with copper cyanide and zinc cyanide is available from the R. & H. Chemicals Department, E. I. duPont de Nemours & Co., Inc., Wilmington, Del.

REDUCTION UNITS. A 32-page catalog No. 1415 is available from the Link-Belt Co., Philadelphia, Chicago and San Francisco, giving horsepower and other engineering data, dimensions, diagrams on single, double and triple reduction units of the herringbone-gear type. A full line of flexible couplings is also shown.

ROLLERS. Bulletin No. 263, entitled "The Bearing Value of Rollers," is available from the Engineering Experiment Station, University of Illinois, Urbana, Ill., for 40 cents.

ROLLER BEARINGS. Roller bearings for printing presses are described in a catalog issued by the Bantam Ball Bearing Co., South Bend, Ind. This catalog is well illustrated and shows several special bearings for printing press mechanisms.

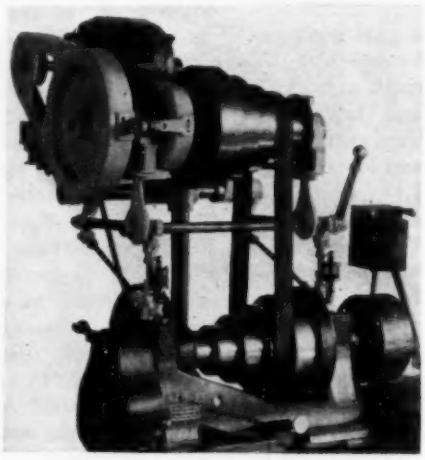
SCREW THREADS. Bulletin No. 264, "The Strength of Screw Threads under Repeated Tension," has been published by the Engineering Experiment Station, University of Illinois, Urbana, Ill. The price is 25 cents.

"THE TESTING AND QUALIFICATION OF WELDERS." Under this title The Linde Air Products Company, New York, N. Y., has published a 23-page pamphlet with numerous illustrations and with a summary of existing and pending qualification tests for welding steel plate and pipe such as the A.S.M.E. Unfired Pressure Vessel Code, the A.S.A. Pressure Piping Code, (unofficial), and the specifications and standards covering welding of steel and wrought iron pipe issued by the Heating and Piping Contractors National Association.

WELDING LENS. A leaflet on the importance of the proper selection of protective welding lens is being distributed by the Lincoln Electric Co., Cleveland, Ohio.

"Remco" Motor Drives

The Manley Products Corporation, York, Pa., has developed a line of "Remco" motor drives for lathes, drill presses, milling machines, shapers, and miscellaneous machines. Illustrated is a front view of one of these drives applied to a lathe. The entire drive is carried on a round column connected to a bracket at the rear of the machine. Triangular truss members are carried to the bearing caps on the machine spindle. This construction affords rigidity. The original countershaft cone pulley may be salvaged, and the proper countershaft speed is obtained through a reduction from the motor. Primary drive is obtained by silent or roller chains. Any standard make of motor can be mounted on the rails. Special clamping devices permit adjustment of these rails to suit all conditions.



Front view of Remco Motor Drive applied to a lathe. Quick changes in speeds are secured by rocking the entire drive on a pivot by means of eccentrics so that the necessary belt slack is quickly secured

The entire driving mechanism is balanced on a rocker shaft carried in a horizontal bearing at the top of the main column. Eccentrics at the front allow rocking the entire drive up or down to obtain slack in the belt when it is desired to change speeds. In fact, it is claimed that speed changes secured by this mechanism can be made more quickly than by the use of sliding gears and clutches in a geared-head lathe.

The drive is adapted by attachments to suit other machine tools. In the case of lathes, five models are available covering machines from 8 to 40 in. swing. Several models are built for use on upright drills, radial drills, gang drills and other types.